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# REPORT OF THE SECRETARY OF AGRICULTURE - 1926





REPORT  
OF THE  
SECRETARY OF AGRICULTURE



1926



WASHINGTON  
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## REPORT OF THE SECRETARY OF AGRICULTURE

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WASHINGTON, D. C., *November 1, 1926.*

To the PRESIDENT:

### THE YEAR IN AGRICULTURE

Further moderate improvement in the agricultural situation as a whole has taken place during the last year. Certain regions have suffered reverses, notably the cotton States, whose principal crop, produced in exceptional abundance, is selling at very low prices. Parts of the spring wheat States have harvested a poor crop. Generally speaking, however, the position of agriculture is better now than it has been in any year since 1920. Livestock raisers, dairymen, and winter-wheat growers have earned good returns, and underlying conditions in the Corn Belt have improved. The year, in short, has been similar to the last few years in that it has seen marked but not uniform improvement in agricultural conditions.

Since the depression period of 1920-21 every agricultural section of the country and every important branch of agriculture have made progress. Recovery has not been uninterrupted; nor, as I have indicated, have all groups of producers shared in it equally. Nevertheless, the gain has been substantial. For the crop year 1925-26 the net income of the agricultural industry as a unit is estimated at about \$2,757,000,000, or 4 per cent more than for the crop year 1924-25. In the same period the net return on the value of the capital invested in agriculture was about 4.6 per cent, compared with 3.1 per cent in the crop year 1922-23 and only 0.6 per cent in the crop year 1920-21.

Unfortunately, the recent slump in cotton prices makes it doubtful whether the crop year 1926-27 will carry forward the story of improvement at the rate established in the last few years. An average price of about 18 cents a pound for the estimated cotton crop would be necessary to yield the cotton States an income equal to that of last year. Recently the farm price of cotton has been around 12 cents a pound. While there are prospects that this extremely low price will be only temporary, it does not seem probable at this writing that returns to the cotton growers will be satisfactory. It is also true that over much of the country farmers are still struggling with a burden of debt and reduced buying power.

### Difficult Problems Persist

Even a good year, therefore, would have to be spoken of in terms of improvement rather than of full prosperity. The situation con-

tinues to present problems of heavy production and some lingering disparity between the prices of farm products and the prices of industrial goods and services. These facts must not be forgotten. On the other hand, they should not blind us to the real gain that has been made. If the Cotton Belt is the black spot in the agricultural picture for the time being, it does not darken the whole of the picture by any means.

It is impossible to appraise the condition of agriculture in a given region by considering solely the current price of the principal crop grown there. In the case of the Cotton Belt, for example, we have to set up against the present low price of cotton the fact that cotton, until the last few months, had sold at high prices since 1922. In 1922, 1923, and 1924 the South enjoyed a combination of large production and high prices. Because of that fact it is unquestionably better able to meet the present emergency than it otherwise would have been. It has more ample resources wherewith to finance the marketing of this year's crop, and is in a good position to protect itself in some measure against the worst effects of the temporary price slump.

### Position of Leading Crops

It will be convenient to glance briefly at the present situation in regard to the leading crops against the background of the depression period from which we are emerging. Winter-wheat growers have harvested and marketed early an excellent crop of high quality. Wheat is not selling at as high a price this year as it was at this time last year. In parts of the spring-wheat States, where yields were reduced by drought, there is distress. Spring wheat was practically a failure in much of South Dakota and central North Dakota. Indeed, all crops suffered there. A great deal of the area seeded was not harvested. Business conditions have naturally been affected adversely. In northern and eastern North Dakota, however, the situation is much better. The Mountain States, particularly Montana, have made good progress this year in recovery from the effects of the depression. It may be said, indeed, that over the greater part of the wheat States conditions have been good for three years. In 1924 our wheat farmers produced 863,000,000 bushels, and for what they sold they received an average price of \$1.28 a bushel. In 1925, with a crop of only 669,000,000 bushels, the average price received for wheat sold by farmers was \$1.46 a bushel. This year high yields in many States will compensate most farmers for the drop in the price.

### Corn Belt in Better Shape

In the Corn Belt conditions are now somewhat more favorable than they have been for several years. There is a tendency toward a better balance between corn production and hog production, and therefore between corn prices and hog prices. Although there is no undue surplus of corn as there was last year, there is enough of it on hand to fatten a probably increased number of pigs. It is well to bear in mind, however, that the supply of corn is still large, and that a hog-cholera scare is reducing the number of hogs. Similar optimism

is warranted in regard to the livestock industry generally. There was a lack of balance in that branch of agriculture in 1925. Corn, oats, and hay were heavy crops, while the number of animals to be fed, especially hogs, was relatively small. Livestock producers were therefore unable to take full advantage of the low price of feedstuffs. That trouble has now been fairly well corrected, and the livestock industry in general is in a stable condition. The range country has had a good year. Cattlemen have done fairly well, and there is a growing optimism among them. Those who have the resources to do so are stocking up their ranches. Prices of breeding stock have advanced for the first time in five years. The cattle industry is moving once more toward prosperity.

#### **Sheepmen in Fifth Good Year**

The sheep industry is enjoying its fifth consecutive prosperous year. It is apparently still expanding. Prices for wool and lambs at present are perhaps not high enough to encourage continued expansion of the sheep industry except in areas especially suited to it. They are high enough, however, to justify the statement that the sheep industry as a whole is in a very satisfactory condition. It is a favorable augury that world stocks of old wool were reduced to a low point at the end of last season.

On the whole the dairy industry has been in a relatively favorable position since 1921. Its products did not suffer as great a slump in prices during the depression as those of the grain and meat industries and it did not remain depressed so long. Comparatively low prices caused some apprehension among dairymen in 1924. Last year, however, the markets for dairy products began to reflect a better balance in production, and this year dairymen in the East and North have had fairly good returns.

In the far West the present year has been one of continued improvement on the whole. The Pacific coast had an early and favorable crop season in contrast with the East and has done reasonably well with grain, livestock, truck crops, and citrus fruits, but apples, pears, and peaches have been low in price.

#### **Crop-Readjustment Results**

This brief summary of agricultural conditions shows that farmers are getting results from the steps they took, following the depression of 1921, to curtail overproduction and to bring their leading enterprises into profitable balance. This undertaking bore substantial fruit in the first years after it was started. Last year, however, it became apparent that in most lines (cotton being an outstanding exception) practicable readjustments in production had largely been made. Farmers, therefore, sought other means of improving their lot. They paid particular attention to improving the quality of their output and toward regulating to better advantage its movement to market. It seems reasonable to credit to these activities a considerable part of the improvement that has been effected in the general situation. Agriculture is now unquestionably on the upward grade, as a result in large measure of the intelligence, energy, and determination of the farmers themselves. I look forward with



confidence to further progress from the same causes. This is not to say that everything necessary for the reconstruction of agriculture on a sound footing can be done by the farmers themselves. Later I shall have some remarks to make on the assistance agriculture is entitled to ask from other groups in the community and from the Nation. Just here, however, I want to emphasize what the farmer can do for himself by efficient production properly regulated to the demands of the market.

### Variations in Efficiency

Many farmers can improve their methods with profit to themselves. There are great variations in the efficiency of production on different farms. Some dairy farms produce 100 pounds of milk with \$1 worth of feed, while on other farms \$2 worth of feed is required to produce the same quantity. On some farms a bale of cotton is produced with 200 hours of labor, while on others, where natural advantages are just as great, 300 hours are required. Some hog raisers manage to produce 100 pounds of pork for every 250 pounds of grain fed to hogs. Others use more than 500 pounds of grain in the production of 100 pounds of pork. These examples indicate some of the possibilities that exist for increased efficiency on the farm. Similar variations in efficiency and similar possibilities for improvement exist in farm enterprises in all sections of the country.

There are opportunities for farmers to improve the quality as well as to lessen the costs of their production. It should not be forgotten that high-quality goods cost no more to ship than low-quality goods. They consequently leave a bigger margin for the producer after all expenses of marketing have been paid. Efficiency in production does not mean maximum production per acre nor does it necessarily mean production at the lowest cost per unit of production. The farmer is most efficient who uses the methods that will give him the greatest returns from his farm as a whole. This aim clearly calls for attention not only to the unit cost of production but to the quality and the volume of the things produced. However, it should be remembered that increasing efficiency in production will not by itself result in permanently improved income for agriculture as a whole. If farmers in general let lower costs and temporarily larger returns encourage them to increase the total volume of their production too much, they will drive down prices as fast as they reduce their production costs.

### Problem Has Many Aspects

In considering what can be done for agriculture by collective action among farmers, by other groups in the community, and by the Nation acting through governmental agencies, it is well to bear in mind that the farm problem must be approached from many angles. Much recent discussion has emphasized the surplus problem as the root of the farmers' difficulties. Surpluses of various crops unquestionably exercise an influence on prices entirely disproportionate to their amount. Moreover, difficulty in the disposal of surpluses is not confined to any one section of the country or to any particular class of farm enterprises. It is a difficulty that dairymen, fruit growers,

livestock raisers, cotton growers, grain growers, tobacco growers, and producers of nearly every staple farm product have to grapple with from time to time. Nevertheless, the farm problem is not merely a question of disposing of temporary oversupplies, although that is a very important question. It is necessary to deal also with costs on the farm, with taxation, with transportation charges, with merchandising methods, with adjustment of production to probable market requirements, and with many other matters. With the more important of these I shall deal in some detail later in this report.

### THE SURPLUS PROBLEM

As to the surplus problem, there are two general avenues of approach to its solution. One is through a better adjustment of production to market requirements. I recognize the difficulties of controlling production, but I am convinced nevertheless that through organized and well-directed efforts much more can be done than we have hitherto done to eliminate the recurring surpluses that prove so detrimental to the farming industry. Our accomplishments in this direction since the war indicate possibilities for the future.

The other approach is through marketing. It seems to me that the central problem is one of merchandising. Better control of the movement of agricultural products into consumption channels is needed. This means that adequate marketing, storage, and credit facilities must be available and that producers must be organized to act together in their marketing operations. An orderly flow of products to market, I believe, can best be effected by farmer-controlled agencies. Legislative action should be designed to create and enlarge such agencies and supplement their efforts. No general formula will cover all commodities and all regions. Every region and every commodity has its special marketing problems. What is needed is concentrated and coordinated effort backed up by adequate resources. To do this may require further enabling legislation.

As I have frequently stated, the great need to-day is to give the farmer greater bargaining power through centralized selling brought about by the consolidation of our existing cooperative associations along commodity lines. There are many advantages in cooperative effort, and I shall touch upon them more in detail in my discussion of the cooperative marketing movement. What we are concerned with here is the subject of agricultural legislation as it relates to marketing.

Many of our recent agricultural laws have been directed to the marketing of farm products. The United States warehouse act gives to the farmer a warehouse receipt for his stored products which is universally recognized as sound collateral for loans. Cooperative organizations are making constantly wider use of Federally licensed warehouses. The intermediate-credit banks established under the agricultural credits act of 1923 are extending credit to organized farmers, and this credit fits well into cooperative effort. These and other acts have made a real contribution to the marketing of farm products.

### Funds Needed for Marketing

If we are to give particular attention to centralized cooperative effort, even present credit facilities may not be sufficient. Coopera-



tive associations are not able to obtain sufficient cash advances on their products to enable them to practice orderly marketing in a complete sense. At the best they can only obtain 65 or 75 per cent of the going market price of their products, and there are thousands of farmers who can not operate on this basis, for their current expenses demand more nearly the market price at the time the crops are harvested. For the same reason many of them can not join a cooperative association.

If additional funds were available to make advances to cooperative associations in addition to credit available from existing agencies, they could make liberal payment to members at the time the products were delivered and their power to regulate the movement of products into consumption channels would be greatly enhanced. It would be possible for them to carry surplus production from one season to another. The individual farmer would have the money for his products but would not lose control over them.

Action of this sort would tend to stabilize the prices of farm products. This is a very different thing from price manipulation. Studies made by the department show that over a relatively few years the production and market requirements of most farm products are in fair balance. This indicates that a program of orderly marketing, with resultant stabilized prices, is easily within the realm of possibilities. Such a program would not menace the interests of consumers but would contribute materially toward the general stability of supply and markets.

#### Consumers' Interests Safeguarded

It may be well to emphasize the fact that no hardship to the consuming public is caused by a program of stabilized prices. Periodic and seasonal depressions in the prices of farm products are not reflected in corresponding declines in prices to consumers, but they play havoc with the agricultural industry. A sound program of price stabilization would guarantee an even flow of products to the consumer at fair prices. It would thus be a benefit to both the producer and the consumer. Agriculture does not lend itself to monopolies or to improper price manipulation. Attempts have sometimes been made by agricultural organizations to exact prices out of line with basic supply and demand conditions. The result has invariably been unfortunate for the authors of the plan. Efforts at price stabilization in harmony with supply and demand conditions, on the other hand, are quite generally successful. Organization of farmers in cooperative associations formed on a commodity basis seems to me the best way to stabilize prices.

#### DEVELOPMENTS IN COOPERATIVE MARKETING

This opens up the general subject of cooperative marketing. Gluts and wastes can not be overcome, nor can the spread between what the farmer receives and what the consumer pays be narrowed sufficiently until effective machinery has been set up to feed farm products into the markets of the country in an orderly manner and at a rate consistent with consumption requirements. This is a formidable undertaking. There is a natural division of interests between

different agricultural sections of the country. Farmers of the East are heavy buyers of western grain. The South is a heavy buyer of northern pork products, grains, and feedstuffs. The North is a buyer of cotton products. Even within the same region the grain grower's finished product may be the livestock feeder's raw material. Our marketing policy should have regard for the interests of agriculture as a whole. A plan of organization that will work fairly and effectively as between the cotton producers of the South and the milk producers of the New England States, the corn growers and the hog raisers of the Corn Belt, the citrus growers of California, Florida, and Texas, the cattlemen of the range and beef-cattle States, the potato growers of Maine, Idaho, Wisconsin, and Minnesota, and the producers of all the other crops grown in this country, can not be improvised in a moment. I believe, however, that we are on the right track when we emphasize the commodity principle in cooperative organization.

### Coordination of Units Needed

It is obvious, of course, that cooperation will not do much for the wheat grower if 5,000 or 10,000 associations try to operate in wheat independently of one another. There is needed a coordination of local cooperative units and a central sales agency. Only by such means can farmers expect to have any effective bargaining power in the wheat market. But a wheat cooperative with a central sales agency that had in its possession from 100,000,000 to 200,000,000 bushels of wheat might help materially in stabilizing wheat prices.

The United States has become great industrially largely through mass production, which facilitates elimination of waste and lowering of overhead costs. Large-scale organization in the business world has effected tremendous economies both in production and distribution, and has enabled manufacturers to supply consumers with what they want when they want it. It seems to me that in this matter agriculture must follow the example of industry. It must have a similar large-scale development of its business organization, managed by competent executives. There are 6,500,000 farmers, each representing a unit of agricultural business. It is therefore not easy to organize agriculture for effective business operations. But the start that has been made in that direction indicates that it can be done.

Natural limits to the extent to which cooperative marketing can be centralized are set by the fact that each basic agricultural product presents problems of its own. It is obviously impracticable to have wheat growers, cotton growers, fruit growers, and livestock raisers all in the same organization. So far as I can see now, there ought to be separate organizations for each leading commodity. But there ought not to be too many competing organizations each striving to handle the same product. When a crop is handled by several hundred small concerns, whether they are cooperative or private, there is bound to be confusion, price cutting when supplies are heavy, market gluts, and other conditions that result in heavy losses for which the producer must pay.

I have already mentioned the possibilities open to wheat growers through the federation of local cooperative organizations. It is necessary to have local farmer-owned elevators. Local cooperative

units are necessary for assembling and shipping wheat. Local organizations, however, can not exercise any effective bargaining power unless they follow a limited marketing policy. Such action is, of course, impossible without an overhead selling agency representing them all.

### Building Bargaining Power

What we need, in short, is organization, both local and regional. Our cooperative marketing agencies should be organized on the broadest scale compatible with effective dealing with the special problems presented by the different branches of agriculture. As I have mentioned wheat several times in this connection for purposes of illustration, I may as well amplify my point by further reference to that commodity. There are about 4,000 farmers' elevators in the United States and no fewer than nine wheat pools. These elevators and pools, however, do not conduct any common policy. As a result they have probably little more bargaining power than have individual wheat growers. But if they were federated our wheat growers' organizations would be in a position to exercise a very considerable influence on market conditions. It is not necessary for a cooperative association to handle the whole of a crop in order to have some say as to its price. It is often enough to control merely the surplus beyond what is required for current consumption.

Farmers can unquestionably exercise effective bargaining power through commodity organizations representing a majority of the heavy producers of the crops handled by the organizations. In that way they can prevent disastrous ups and downs in prices, cause a steady flow of products to the best markets, and exert some influence on production. It is important that farmers' organizations should not confine their work merely to regulating the flow of agricultural products to market. They should seek to adjust production as well as marketing to consumption requirements. Effective agricultural cooperation begins at seeding and planting time, and in the case of many crops ends only when the product is turned over to the processor or to the consumer. When farmers' business organizations take this broad view of their functions they can make a real contribution to the stability and progress of agriculture.

### Required Degree of Organization

What proportion of the producers must be organized in cooperative associations to get the best results is a keenly debated question. Enthusiasts will not be content with anything less than 100 per cent organization. As, however, this end is not likely to be reached for a long time, if ever, we shall do well to bear in mind the demonstrated fact that cooperative marketing is not dependent for its success on the inclusion of all farmers in its organizations. Cooperative organization is often measurably effective even when very incomplete. It is true that a cooperative association controlling only part of a given crop may sometimes confer more benefit on nonmembers than on members. It may enable nonmembers to get better prices than would otherwise be obtainable, without saddling upon them any of the expense or risk involved in the operation of stabilizing the market. However, that is a liability which the cooperative



movement in its earlier stages can hardly avoid. It will tend to diminish as the farmers become better informed about cooperation and join cooperative associations in larger numbers. Eventually, no doubt, a situation like that seen in the case of certain great industrial organizations will arise, wherein unorganized "independents" find themselves more or less obliged to fall in step with the general marketing policy laid down by the dominant organized group.

### **An Objection Answered**

It has been suggested that farmers who produce many crops will find it impossible to participate advantageously in cooperative marketing through organizations formed on commodity lines. The idea is that they can not be expected to join a sufficiently large number of different associations. This seems to me a very trivial objection to the method of organization which I am advocating. It would seldom be necessary for farmers to belong to more than two commodity organizations, since few farmers produce more than two different major crops. The average farmer can not expect to do the whole of his business through cooperative agencies, for the present at any rate. A wheat farmer in the Red River Valley of Minnesota, for example, would probably find his interests sufficiently protected by membership in a wheat cooperative. Conversely, a dairy farmer in the same State, with only a small wheat acreage, would probably be content with membership in a dairy cooperative. As a matter of fact, however, thousands of farmers already belong to more than one farmers' marketing organization without getting their affairs unduly complicated.

Cooperative associations reporting to the department at the end of 1925 had on their membership rolls a total of 2,700,000 producers. Allowing for duplication, owing to the fact that many farmers are members of two or more associations, and for inactive members, it is conservative to state that approximately 2,000,000 farmers are now engaged in cooperative marketing. The membership of cooperatives to-day is more than three times as great as in 1915, when it was approximately 651,000. The total business of cooperative associations in 1915 was \$635,800,000. In 1925 it reached approximately the huge total of \$2,400,000,000.

### **Possibilities of Cooperative Marketing**

A large-scale efficiently managed cooperative can effect three fundamental improvements in the marketing of farm products: (1) It can standardize grades and handling methods; (2) it can develop an effective merchandizing program; (3) it can give the farmer information which will enable him to visualize market conditions six months or a year in advance, and thus assist in making adjustments in his production plans.

The development and use of grade standards has come about largely because of the demands of the cooperative associations. In pooling the products of their members, the cooperatives must have grades so that they can make returns to the growers in accordance with the market value of the product each one produces. The cooperatives have also found that the standard grades make trading

easier, reduce wastes, and promote wider distribution and increased consumption.

The cooperative associations can do a better job of merchandising farm products than the individual producer. Merchandising means more than taking orders. The aim of the selling program of a cooperative should be service to its members and its customers. A thorough study of the price and demand history of a commodity and a knowledge of the present and potential supply are essential before the correct selling program can be determined for that commodity. The association must know the supply of the product and of competing products. An association selling oranges must be informed regarding the apple crop, because apples come into competition with oranges. If there is an unusually large crop of Italian lemons, the California lemon growers must take that fact into account in their price and sales policy.

Furthermore, the association must know the markets and the factors that affect prices. When it has collected all this information, the association must use it to guide its price policies; it must determine the markets in which it will attempt to sell, the quantity it will offer each day or week, and the trade channels it will use. Only a large-scale organization can do this job efficiently.

#### **An Example of Market Information**

As an example of information that may be used to guide the marketing policies of cooperatives, studies by the Bureau of Agricultural Economics of the relationship of wheat supply to prices may be cited. The world supply of wheat—especially the supply of the Northern Hemisphere—has a greater influence on price than the supply in the United States, whenever there is a surplus for export. Hard spring-wheat production is frequently sufficient only for domestic requirements, but there is usually a surplus of other classes. The relationship for a period of 25 years of the supply of wheat in the Northern Hemisphere (production plus carry-over) and the supply in the United States to price has been calculated. From these studies it is possible to determine the usual relationship between supply and price during these years and to use the information in estimating probable movements in the future.

Finally, the cooperative associations can furnish the producers information by which they can adjust their production in the light of market requirements. Cooperation must reach back to production, guide the organization of farm enterprises, and direct the production programs of the members. The problem of agriculture at the present time is largely one of coordinating production. To a large extent each of 6,500,000 farmers produces farm products without reference to the plans of his neighbors and without consideration of the factors which will be instrumental in determining whether he produces at a profit or loss.

Cooperation is already having an important effect upon production. Among the fruit growers, undesirable varieties are being eliminated and the quality of the fruit grown is being improved by better cultivation, fertilization, and spraying. The milk producers are delivering a product testing higher in butterfat and lower in bacterial



count. Cotton growers, who are paid through their cooperative associations according to the grade and staple of their crop, are making fruitful attempts to plant only standard varieties and to avoid damage which lowers the grade of their cotton.

A few of the milk producers' organizations have been able to go further in influencing production than the examples given. An association in an eastern market, for example, adopted some years ago a "basic price" policy in making payments to its members. By this plan, the quantity of milk delivered by each member in October, November, and December was rated as "basic milk" and paid for at fluid-milk prices. Each member receives the fluid-milk price for the same quantity delivered each month from January to September, but "surplus milk" delivered during these months—that is, the quantity in excess of his average production during October, November, and December—is received at a lower price which is based on the price of 92-score butter in New York City.

### Wholesale Production Shifts

The results of this policy have been a wholesale shift in production. The last three months of the year were formerly months of scarcity, and the early spring and summer months saw large, unmanageable surpluses of fluid milk coming on the market. During 1925, the average deliveries to this association from January to September exceeded those of October, November, and December by only 10 per cent. In other words, the dairymen were able by changes in their practices to maintain practically as large a flow of milk during the late fall and early winter months as during the remainder of the year. The milk supply situation has been stabilized so that seasonal surpluses are no longer a serious factor. Partly as a result of this stabilization, prices to the producers have been among the highest paid in the eastern United States, while prices to the consumer have been from 1 to 2 cents a quart lower than those paid in most large Eastern cities.

### Pitfalls of Cooperative Marketing

Failures in cooperative marketing have not been unusual, considering the number of associations formed and the volume of business transacted. From 1920 to 1925, years for which the department has reasonably accurate records, the largest number of failures reported was 194 in 1923, 1.9 per cent of all associations reporting to the department that year. Failures in 1925 were only 0.3 per cent of the more than 10,000 cooperative associations reporting during the year. The failure of cooperatives which have gone out of business can be traced, in most cases, to a few well-defined causes.

Chief of these, according to reports received from former members and officials of approximately 1,100 defunct associations since 1913, is failure to obtain a sufficient volume of business to make possible economical and efficient operation. The causes which lay behind this situation are often somewhat obscure. The commodity may not be produced extensively enough in the community or region to justify the organization of a cooperative association. For example, a number of cooperative creameries were formed in Kansas,

during the nineties, in communities that were not dairy sections and offered no prospect of developing into such in the immediate future. Consequently a large number of failures followed. Again, the sentiment of the producers in the region may not be favorable to cooperative marketing, or there may be antagonism created by the policies of the management, or lack of confidence in the ability of the management.

Members of cooperative associations which fail because of insufficient business very frequently ascribe the failure to poor management. In more than half of the 1,100 suspensions of which the department has record, inefficient management was given as the sole or one of the chief causes of failure. Wisely planned and intelligently directed management is by far the most important element in business success and lack of it the most certain cause of failure. In speaking of management, I want in particular to emphasize the duties and responsibilities of the board of directors.

#### Directors Have Responsibilities

One of the serious weaknesses of many cooperatives is found in the tendency of members of boards of directors to shirk their responsibilities. Too frequently the individual member elected to the board looks upon his selection as a director in the light of an honor conferred upon him in recognition of his standing in the community and as carrying with it no responsibility. Such an attitude is unfortunate, and until every director comes to feel that he is accepting the trusteeship for the successful conduct of the business, cooperative marketing will fail of its full measure of success.

Changes in economic conditions at times interfere seriously with the operations of cooperative associations. The shift in demand from cigars to cigarettes, for instance, has seriously embarrassed the tobacco marketing associations in the cigar-leaf sections. Some cooperative creameries have gone out of business because the growth of near-by cities has opened up a fluid-milk market for their members. During and immediately after the war, the high prices paid by condenseries put out of business a number of cooperative creameries and cheese factories, many of which had been operating for 20 years or longer.

#### Danger in Price Control

Too often in the organization of cooperative associations the idea has been broadcast that control of supplies by the farmers will enable them to fix the prices of their products. This doctrine has been a factor in the failure of some cooperatives. The price which a cooperative obtains for its products is determined by the supply of the product and the demand for it. Not only the supply in the possession of the association but that controlled by other shippers and produced in other sections of the United States and in foreign countries influences prices. The supply and price of competing products are also factors. Wheat competes with corn and rye as a bread grain; cotton with wool and artificial silk; and potatoes with sweet potatoes and other vegetable crops. The association which attempts

to manipulate prices by withholding its products from the market usually discovers that it has created a more favorable market situation for competing sections and products and has possibly sacrificed the crops of its members. The disappointment resulting from the failure of a program that from the beginning was impossible has in some cases set the stage for failure.

A brief analysis of the price history of various commodities will illustrate the difficulties that a cooperative association would encounter in attempting to fix prices arbitrarily. Although all the raisins produced commercially in the United States are grown in a limited area in California, and a cooperative association should control 85 per cent of the output, it could not maintain a profitable price level when confronted by huge domestic production and the growing competition of foreign countries. Much less could this cooperative, apparently ideally situated to control price, maintain, if it were so inclined, an arbitrarily high price level. Plans for monopoly control set up an objective that can not be attained. Such plans obscure the real possibilities and purposes of cooperative marketing, and in the long run are harmful to cooperation and to the development of efficient marketing.

#### Success Based on Service

The associations with a record of accomplishment have been successful because of the superior service they have been able to render their members and customers and not because they have been able arbitrarily to fix prices. As one definite example, the experience of a woolgrowers' cooperative association, with headquarters at Columbus, Ohio, may be cited. This association was formed in 1918, and in eight years (1918-1925) has marketed 25,139,000 pounds of wool produced by Ohio, Indiana, Michigan, and West Virginia growers. Its average net returns to its members have exceeded the average of local Ohio prices each year by amounts varying from 2½ cents per pound in 1925 to 8 cents in 1921 and 1924 and 9 cents in 1922. This represents increased returns to its members totaling over \$1,500,000 for the eight years, without considering the effect the activities of the association may have had on local prices and buying practices. The members in addition are the owners of a wool warehouse in Columbus which was purchased in 1920 for \$125,000.

The success of this association has been due, first, to the education of its members with regard to wool grades, the care of the flock, and the preparation of the clip; second, to the practice of selling direct to the mills. It markets wool throughout the year and supplies each mill the grade of wool that will meet its needs, prepared in such a way that it can be handled with a minimum of waste. These are services to its customers which enable the association to obtain a premium for a large part of its wool.

In the marketing of fluid milk a California cooperative association has made progress, which is typical of a number of successful fluid-milk organizations. This association was formed in 1915, and operated as a price bargaining association until 1920. In that year it acquired 60 per cent of the stock of a retail milk-distributing company at Los Angeles, and now is sole owner of this company.



### Milk Handled Through Subsidiary

At the present time 41 per cent of the milk produced by members of the association is distributed to the consumers through this subsidiary company. From 26 milk routes in 1920, the business had grown to approximately 200 milk routes at the beginning of 1926. The remainder of the milk delivered by members of the association is sold to other distributors, and during periods of surplus a portion is manufactured into by-products. Improvement of the product and the coordination of marketing machinery have stabilized returns to the producers. In 1925, milk to the value of \$5,570,032 was handled by the association at a cost of 1.2 per cent.

A cooperative association marketing cotton has found that its chief possibilities lie in giving its customers—the manufacturers—superior service. The spinner wishes to purchase cotton in “even-running lots”—that is, all of the same grade and character. He wants cotton which meets his special needs. The officials of the association quickly recognized that they must first ascertain the needs of their customers, then develop standard “types” which meet these needs, and deliver the exact grade and staple length which the customer desired—not once, nor occasionally, but continuously. This appears to be a simple problem, but it is really very difficult for any agency but a cooperative association to meet it satisfactorily. The association can give its customers “even-running lots” because it has some 200,000 bales from which to select the exact cotton each buyer requires. By its system of classification and records it knows the grade, staple length, and weight of each bale, the warehouse where it is stored, and the grower who produced it. The dealer who sells 100 bales to a manufacturer with the expectation of buying this cotton—1 bale or 10 bales at a time, as it becomes necessary to make deliveries—can not guarantee the uniformity of his shipments with the same assurance as the cooperative association which *knows* it has that exact type of cotton on hand.

### New Cooperative Law

The legislation enacted by Congress has been wisely planned to free the cooperatives from undue restrictions and to assist them in meeting their problems. The Capper-Volstead Act, which became a law in 1922, recognized the right of producers to organize cooperatively, and removed the threat of prosecution under Federal anti-trust statutes of cooperatives conducting a legitimate business.

The past year has been signalized by the passage of the act to create a division of cooperative marketing in the Bureau of Agricultural Economics. This bill was drafted after conference with cooperative leaders representing all commodities and all sections of the country. It is designed to enable the department to conduct research studies and furnish service which will aid in the development of the cooperative movement. Research designed to test existing business and marketing methods, education in the principles and practices of cooperation, and such service to the cooperatives as can be rendered by a fact-finding agency are the objectives of the new division.

Research in the business and marketing methods of cooperation, such as the department is undertaking, is not a theoretical abstrac-

tion but can be made of practical help and guidance to the associations. The need of the cooperatives for the assistance research can furnish is probably greater than that of private business. Each advance made by cooperative associations calls for a careful study of the conditions under which they must operate. They require a type of research that not only deals with established methods and practices but looks forward to changes which the development of cooperation will introduce.

### Commodity Studies Begun

The division of cooperative marketing is studying at the present time the cooperative marketing of cotton, grain, livestock, fluid milk, and fruits and vegetables. A study just completed of the costs and operating practices of cotton gins may be cited as an example of the work that is being carried on. This study was undertaken in anticipation of the interest which exists among the members and officials of cotton-marketing associations in the formation of local cooperative gins. They will have, as a result of this study, definite information to guide them in forming their ginning associations, and an understanding of the possibilities and problems of this form of organization.

A project dealing with the organization, operating, financial, and selling problems of individual cooperatives was inaugurated early in 1925. This work will be expanded under the provisions of the cooperative marketing act. The demand for studies of this kind indicates the interest among cooperative associations in a close analysis of their business and merchandising operations and in the external factors which affect the prices received for their products. The object in conducting analyses of the business of individual associations is primarily to accumulate a sufficient number of cases to set up operating ratios and standards for cooperatives, and to study by a case system the economics of cooperative marketing. It is essentially a research project, although the development of methods that will enable the cooperative associations to study their own problems is an immediate service.

### Employment of Specialists

The act makes possible also the employment of specialists who are versed in cooperative marketing and familiar with the problems of particular commodities. These men will have two functions; first, to collect statistical and other information made available by the Department of Agriculture and other agencies, and disseminate it to the cooperatives in such form as will be most useful; second, to outline and assist in marketing research and service required by the cooperative associations. These men will have a helpful personal relationship with cooperative organizations, and to a certain extent will be a connecting link between the associations and the men and agencies engaged in research work.

The department expects to cooperate with and assist schools for instruction in cooperation which are being conducted by agricultural colleges and cooperative associations. The growing interest in this instruction is indicated by the increased attendance of members,

directors, officers, and employees of cooperatives who spend a week or more at these schools learning the general facts regarding cooperation and the details of financing, accounting, and merchandising methods. The department can make an important contribution by assisting in the development of programs for these schools and by bringing a national viewpoint to those who are considering State and local problems. The dissemination of knowledge regarding the principles and aims of cooperation is one of the major problems of the movement. It is the foundation of sound cooperation.

The department, under the cooperative marketing act, intends to render services which will promote and foster cooperation. The act does not give the department regulatory control over the cooperative associations in any degree. It has never been the policy of the department to attempt to seek such control. Neither does the department intend to undertake any of the functions which the cooperatives themselves were organized to perform. The work of the department will be confined to those research, educational, and service activities which it is peculiarly fitted to perform, and it will be guided in this work by the developing needs of the cooperative organizations.

### AGRICULTURE'S UNCONTROLLABLE EXPENSES

Farmers can do something toward regulating their output and reducing their costs of production and marketing, but many items of farm expense are virtually outside their control. Overhead expense for taxes, interest, insurance, and depreciation is determined largely by factors over which the individual farmer has little influence. This is not to say, however, that nothing can be done toward keeping the fixed charges of the agricultural industry within bounds. Collectively, farmers can accomplish much. I shall refer in detail later to taxation. As a voter, the farmer has some say as to taxation, but his is not by any means always the deciding voice. He often finds himself saddled with a disproportionately high tax burden for public expenditures that benefit him considerably less than they benefit other groups in the population. I shall give some instances of this sort of thing when I take up the general subject of taxation.

Interest charges are another farm expenditure not determined by the individual farm operator. Much has been done in recent years toward reducing the burden of agricultural interest rates for both long and short term credit. Agriculture needs three types of credit. It needs long-time loans on land, short-time credits for six months or less, and production credit running for terms from six months to three years. The establishment of the Federal land banks and the joint-stock land banks has provided admirably for land loans. These banks have loaned more than \$1,698,000,000 on terms that have relieved farmers and ranchmen of high interest rates and given them a great incentive to thrift.

#### Intermediate-Credit Facilities

Our commercial banking system in general provides short-term credit for agriculture in most regions, although certain districts are



still not well served. Facilities for furnishing intermediate credit are now available through the intermediate credit banks which have been set up under the agricultural credits act of 1923. These banks provide a means of advancing all the money that can be prudently employed in the production of livestock or in the marketing of such agricultural commodities as can be insured and safely warehoused. They can loan it, moreover, on conditions that free the producer from worry as to whether his loan may be called before he can finish the undertaking for which he obtained it. Comparatively little advantage, compared with their possibilities, is taken of the facilities offered by the intermediate credit banks. However, the cooperative associations are awake to the usefulness of these institutions.

There is a close relationship between the intermediate credit banks and the cooperative movement. More than half the loans of the banks have been made to farmers' cooperative marketing associations. Moreover, the fact that the cooperatives can tap the resources of the intermediate credit banks has a tendency to make it easier for them to get credit from commercial institutions. That has been demonstrated over and over again. Cooperative associations can get money more easily and on better terms from commercial banks now that they have the intermediate credit banks to fall back on in case of need. The intermediate banks loaned nearly \$125,000,000 to cooperative marketing associations last year to finance production as well as marketing. Many cooperative associations have organized credit corporations which can rediscount the paper of their members at the intermediate credit banks. In this way the resources of the banks are made available to thousands of producers who might otherwise have to borrow for production purposes on very unfavorable terms.

### FREIGHT RATES

Transportation charges, although not overhead in the proper sense of that term, nevertheless are often a burdensome, uncontrollable factor in farm business. Farm commodity prices, especially in areas distant from markets, are seriously depressed by high freight rates. It is my conviction, often stated, that we must have substantial readjustments in freight rates. There have been no freight rate reductions of importance on agricultural commodities in the last year. The Department of Agriculture's index of freight rates indicates that they are still 58 per cent higher than before the war. It is instructive to compare this figure with the index for farm commodity prices, which in September stood at only 34 per cent above the pre-war level.

What rail transportation charges sometimes mean to the farmer can be realized from an illustration or two. It costs 26.4 cents to ship a bushel of wheat from Wichita, Kans., to the Gulf of Mexico. It costs 27.8 cents a bushel on the average to ship wheat from the spring-wheat area to the Atlantic seaboard. These freight costs are large relatively as well as absolutely. They place the American farmer at a disadvantage of from 4 to 10 cents a bushel in comparison with the freight costs of his competitors in Canada and Argentina.

### Rate Increase Refused

In the past year a request from the railroads of the western district for a general increase in freight rates on all commodities was refused on the grounds that no financial emergency exists that would warrant such an increase. The Interstate Commerce Commission is continuing its general investigation of the freight-rate structure as ordered by Congress in the Hoch-Smith resolution, which directs such changes to be made as will promote the freedom of movement of agricultural products affected by the depression, including livestock, at the lowest possible rates compatible with the maintenance of an adequate transportation service.

The freight-rate structure of the country has grown up in a haphazard way, which has resulted in a lack of uniformity in rate relationships and adjustments. An example of this is seen in the relation between rates on livestock and fresh and cured meat. Rates have been recently prescribed on shipments between Chicago and New York, establishing rates on fresh meat not to exceed 140 per cent of the livestock rate. As evidence of the need of a general readjustment is the fact that in contrast to this relationship of 140 per cent which was found reasonable, the relationships between these rates from other competitive points varies from 111 to 147 per cent.

A revision of the freight-rate structure on fertilizers in the South has been made, placing rates on a uniform basis throughout the territory and removing any discriminations that may have existed. It is believed that the revision will result in somewhat lower rates in the aggregate.

### Recognize Farm Conditions

The financial needs of the carriers to maintain their roads adequately must be recognized, but the depressed condition of agriculture in many parts of the country must also be recognized. Where the established rates are yielding more than adequate returns it is reasonable to expect that rates on agricultural products suffering from a depression will be reduced.

The railroads in the southern district, for example, are in a prosperous condition, with earnings in excess of what has been determined to be a fair return. The cotton farmer, on the other hand, is facing a year of low prices for cotton. Should it be determined that the cotton farmer may be facing a period of depression, some consideration should be given to the possibility of revising the rate structure in this territory so as to afford him some relief.

Even where railroad earnings do not run in excess of what has been determined to be an adequate return, some relief may be provided for agricultural products suffering from a depression by shifting more of the burden of the rates from these depressed agricultural products to products that are better able to carry the burden.

### HIGHWAY IMPROVEMENT

We have entered upon a period of remarkable development in our highway system, a development conditioned quite largely upon the growing use of motor vehicles. It is important to the Nation that this highway development be so directed as to bring good roads

as near as possible to every farmer and at the same time that it be coordinated effectively with other transportation facilities. The program of road building should be in keeping with the needs and resources of the various regions of the country. It is a matter of national concern, and one upon which there should clearly be cooperation between the Federal and State Governments. Detailed information about Federal-aid roads will be given later in this report.

There is no doubt, of course, that the money spent on highways brings a compensating return in reduced expense for the operation of vehicles. This is amply demonstrated by surveys of highway transportation which the Department of Agriculture has made in cooperation with the State Highway Departments of Maine, Connecticut, Pennsylvania, and Ohio. Main intercity roads in these States constitute only one-tenth of their total highway mileage. Nevertheless, there is spent on such roads under the supervision of the State highway departments at least half of their total annual expenditure for highway purposes. They carry a traffic considerably greater than half the highway traffic of the States in question. That owners of motor vehicles believe they benefit from expenditure on highway improvement is indicated by the fact that they now pay in special taxes, without the least objection, an amount which is not less than two-thirds of the annual expenditure of the State highway systems.

Agricultural traffic on these main roads, however, is only a small part of the total. Their traffic is mainly of an intercity character. It neither originates from nor leads to the farm, and therefore helps to improve the condition of the farmer only to the extent that he benefits from whatever general improvement of business conditions the traffic may bring about. In the benefits of main intercity roads, the farmer shares only as he uses them in common with the more numerous users who live in cities and do their business in cities. Clearly, then, it is a mistake to improve such roads by a system of taxation that places the burden largely on farm land. In States in which an effort is made to finance such road improvements in greater or smaller measure by local taxation, there is complaint. The remedy is obvious. Taxation for main road improvement should be on a State-wide basis. There is special appropriateness in the use of motor license fees and gasoline taxes for this purpose.

#### Roads to the Farms

But we have more than 2,750,000 miles of roads not included in State main highway systems. For the improvement and maintenance of these roads, revenue may reasonably be derived from taxation of real property. Most of this mileage is devoted to the service of farm land. Indeed, much of it accommodates no one else than a few farmers. Investigations made in Iowa, Wisconsin, and Illinois show that the improvement of such local roads is invariably followed by reduced farm operating expense. Improved roads to the farm cut down wear and tear on vehicles, shorten the time necessary for hauling, and give the farmer access to comparatively distant markets that otherwise he could not reach. In connection with radio and telegraph service, improved market roads enable the farmer to rush



his products to town when prices are favorable. This advantage is particularly great in shipping livestock. Livestock raisers who live within trucking radius of their market are in a much better position to profit by upturns in market prices than are those who are obliged to depend on rail transportation. The social benefits of better roads to the farm are perhaps even greater than the economic benefits. Good farm roads lessen the isolation of farmers, and make the farms better places on which to live.

It is extremely important to note, however, that the prevailing weight of farm vehicles, which does not usually exceed that of a 1½-ton truck, makes it unnecessary to improve local roads in an expensive manner. Most of them require no surveying; very few need more than a coat of gravel or fairly inexpensive material. When local roads are improved beyond this point, there is no proportionate enhancement in the value of adjacent farm lands. It is a common mistake to overimprove this type of road. No road should be improved by the expenditure of public funds in excess of its earning capacity.

### FARMERS' TAXES IN 1926

Farm taxes remain at almost the same level that they reached in 1925. A partially completed survey by the Department of Agriculture reveals the fact that the total taxes collected from farmers in 11 States are slightly higher in 1926 than they were in 1925. The 11 States which have furnished data contain nearly one-third of the farm acreage of the country and present a fairly accurate indication of the situation as a whole.

Drastic reduction in farm taxes can not be expected at the present time. The demands of the users of automobiles for better and more improved roads and the necessarily high costs of education will keep the expenses of the States, counties, and local units close to their present level. The reduction in Federal expenses gives the farmer little direct assistance, although reduction in Federal taxes may be reflected in lower costs for some of the articles that he must purchase.

Aid to agriculture in meeting the tax problem may come from two sources. In those States where agriculture is not the predominating industry it may be that the other industries are bearing less than their share of the tax burden. Where agriculture is the chief industry of the State there is often opportunity for relieving the tax burden by a readjustment of the tax system. Such a possibility should not be overemphasized. So long as Government costs are high the taxpayers must meet the bills. Readjustments of the burden will aid certain groups, but it will not lessen the total amount that must be collected.

### Farmers Bear Undue Burden

Specifically, the farm group may be aided by a general alteration in both the general-property tax itself and in its method of application. As applied in most of the States, the general-property tax must of necessity burden the farmers to a greater extent than it does the proprietors in other industries. The farmers have a larger proportion of their property in a form that can be reached by the assessor

than do other groups, and it follows that they pay a larger share in the total expenses of government. An obvious solution for this difficulty points toward an attempt to devise taxes that will force other groups to contribute their share. The State income tax has been one means used to reach incomes that escape the general-property levy. Where the examples of New York and Wisconsin are followed and a portion of the receipts from such a tax, 50 per cent or more in these cases, is returned to the counties and local units, some relief is gained.

The importance of using the receipts from income or other taxes that supplement the general-property tax for purposes other than State expenses deserves emphasis. In 1922 the taxes collected by the States and minor civil divisions amounted to nearly \$4,250,000,000. Only 20 per cent of this amount was collected by the States for their uses, the remaining 80 per cent going to the counties, incorporated places, townships, school districts, and other minor divisions. If tax reform is carried on in such a way that it affects only the State taxes it will fail to meet the needs that are greatest. There is in many States a further reason for the distribution to the minor divisions of taxes collected on a state-wide basis. It is becoming common for the State to set certain standards to which the counties, townships, or school districts must conform. In a State where there is uniformity in economic conditions among the various sections, such requirements may not work a hardship on any. Where wealth is unevenly distributed over the State—and it must be recognized that this is the usual condition—it becomes increasingly difficult for the poorer divisions to conform to the standards that have been set up. This situation creates a reasonable basis for the state-wide collection and local distribution of an increasing proportion of taxes.

#### Sources of Taxation

It should be noted that the State income tax was mentioned only as an example of a method that has been used by some States. It is not urged that all States should adopt such a measure. The varying economic conditions and characteristics of the sections of the country make no single measure adequate to deal with the situation. The gasoline tax is another that might be cited as an example of a State-collected tax that is adapted either for distribution among the minor divisions or for use by the State in road building and maintenance to relieve the local divisions of some of their expense. This particular tax, with rates ranging from 1 to 5 cents a gallon, has within the last few years been adopted by practically every State. Forty-four of the forty-eight States were using it at the beginning of 1926. It forms a valuable means of collecting part of the cost of roads from those who use them. It again is only one of a number of taxes that are, and should be, used to relieve the pressure on general property.

Out of the four and one-fourth billion dollars collected by the States and their subdivisions in 1922, about three and a third billion came from general property taxes. That is, over 78 per cent of the total collected was levied on a basis which is especially burdensome to the farmer. The fact that so large a portion came from this source indicates its importance and demonstrates the fact that it



will continue to be the major factor in the tax system of the States. If figures for individual States, particularly those where agriculture is of major importance, are examined it will be found that the general property tax plays a greater part in many of those States than it does in the country as a whole. In Georgia, Illinois, Louisiana, Oklahoma, and South Dakota it was responsible for from 80 to 85 per cent of the total revenue. In Indiana, Kansas, North Dakota, and Texas between 85 and 90 per cent and in South Dakota 94 per cent of the total revenue was derived from this source in 1922. In view of this importance it is desirable to find means by which this tax may be adjusted.

#### Immediate Large Cut Not Possible

The actual amount of the general property tax depends on two factors, the assessed valuation of the property and the rate of the tax. It has been noted that the amount that must be paid by governmental units can not be subject to great or immediate reduction. In certain jurisdictions, however, some relief may be offered by a readjustment of assessments. The sole factor determining assessed valuations can not be income, but this factor should be given increased importance. Through a more flexible system of assessment some of the more striking injustices of the general property tax may be removed. This procedure is not without its dangers, but with intelligent and honest administration, subject to central supervision, it will adjust the burden of the tax more equitably.

Finally, there should be recalled the fact that taxes on agriculture are less likely to be shifted than taxes levied on other groups. The prices of most major agricultural products of the United States are determined on a world basis rather than on a local one. That is, the cost of production of the American farmer plays a comparatively minor part in determining the price he gets for his crops. Production costs of other countries as well as world demand play compelling parts in determining these prices. It follows that the American farmer is not usually able to add his taxes to the prices that he receives for his products and so shift his tax burden to other shoulders. The importance to agriculture of the tax problem is largely increased by this fact.

The primary needs in taxation, so far as agriculture is concerned, are economy of expenditure and readjustment of the tax system so as to reach taxable holdings other than general property and to distribute the burden more fairly among the groups in the States. As economy can not in most cases bring any material reduction in the total costs of government, the second portion of the program deserves increased emphasis. Highway construction must be recognized as a State rather than a local function and financed on that basis. Education, at least where State standards must be complied with, should be paid for in the same way.

#### THE FARMER AND THE TARIFF

Many farmers believe that our tariff system benefits industry greatly and agriculture little or not at all. This is the idea behind the demand for legislation to influence farm commodity prices. Such



legislation, say those who favor it, is necessary "to place agriculture on an equality with other industries in the matter of tariff protection." The same view of the tariff is held by many persons who disapprove of price legislation. These persons hold that the conditions under which the tariff operates make it practically tantamount to price fixing for the exclusive benefit of industry. They naturally conclude that economic justice for agriculture calls for a downward revision of the tariff.

It is usual to declare baldly, without any qualification whatsoever, that industry gets everything and agriculture nothing out of the tariff. This is obviously not the case. Many farm commodities enjoy effective tariff protection. Among them may be mentioned spring wheat in years when we have a short crop, flax, sugar, wool, butter, and even certain classes of livestock.

### Duties and the Farmer's Purchases

It is incorrect, moreover, to say that everything the farmer buys enjoys the benefit of tariff protection. Many articles bought by farmers are on the free list. This is true of agricultural implements and machinery, harness, boots and shoes made chiefly of leather, cattle and horses imported for breeding purposes, rough lumber, fertilizer materials, gasoline, binder twine, and numerous other commodities. On many other articles purchased by farmers the duty is principally nominal and ineffective. A typical example is the duty of  $33\frac{1}{3}$  per cent on furniture. This country has a virtual monopoly of the hardwood lumber supply of the world, and the efficiency of American machinery and labor enables the domestic manufacturer to produce and sell furniture cheaper than furniture manufacturers in any other country.

It often is contended, however, that even where an article extensively used by farmers is on the free list the tariff indirectly affects that article because of duties on raw products entering into its manufacture. Agricultural implements are most frequently cited in this connection. It is true that there is a tariff on pig iron, which is bought by implement manufacturers, fabricated, and used for manufacturing purposes. The tariff is, however, only 75 cents per long ton (2,240 pounds). The freight rate from New York to Chicago, near which the manufacture of agricultural implements is localized, is \$9 per long ton. Pig iron, on the other hand, can be shipped from the mines in Minnesota to the Chicago district for less than \$4 a long ton. Naturally, the Minnesota product is preferred because of the low transportation charges. The situation would be the same if the tariff on pig iron were removed; the \$5 freight difference would effectually prohibit the use of the foreign product.

Still more significant, not only agricultural implements in whole but also in part, including repair parts, are on the free list. Hence the domestic manufacturer is exposed to foreign competition as soon as he charges prices sufficiently above the world price to make the American market attractive to foreign manufacturers. As a matter of actual recorded fact, the farmers of the United States, for the bulk of their farm machinery, pay lower prices than do the farmers of other countries.

Another example consists of automobiles. On these there is a tariff of 25 per cent ad valorem, and there are also duties on certain of the materials entering into their manufacture. Does this affect the farmer in his purchase of an automobile? Not at all. The United States, manufacturing more than 85 per cent of all the motor cars produced in the world, invariably undersells foreign manufacturers on cars of the types used by farmers. If there were no tariff on automobiles and no tariff on iron and other products entering into their manufacture, foreign manufacturers would nevertheless be unable to compete. The tariff on automobiles is a tax paid by the very wealthy who are willing to pay a high price for the privilege of owning cars built in Europe.

### **All Items Not Balanced**

Additional facts could be cited to show the fallacy of the general assertion that the farmer is wholly condemned "to buy in a protected market and sell his products in a world market." Those mentioned, however, will suffice. I am not concerned for the moment to prove that exact justice as between industry and agriculture is brought about by our existing tariff laws. So far as I know, all the items on both sides of the ledger have never been set down and balanced. I merely want to show at this point that the usual methods of condemning the tariff from the standpoint of agriculture are not to be relied on.

It is illogical to consider agriculture as a unit entity and to attempt to appraise the burden carried by this entity as a result of tariff duties on manufactured goods. The farm population must have its purchases segregated into producers' goods, or articles required in the business of farming, and consumers' goods, including the commodities used in all families. Since agricultural producers' goods vary from region to region and from crop to crop, it is misleading to consider them as a unit. If we are to appraise correctly the effects of the tariff on farm-production costs we must find out how it affects different crops.

Statistical material, crop by crop, is lacking for comparison between farm prices received and farm prices paid for producers' goods and for consumers' goods. I distrust comparisons between farm prices and wholesale index numbers. Our lack of comprehensive and trustworthy material on farm prices, incoming and outgoing, makes it difficult for us to define the extent of the disparity existing between farm costs and income. It is therefore impossible to determine to what extent farm costs and farm income are directly or indirectly influenced by the tariff.

### **Benefits to Farmer Large**

Nevertheless we can be quite sure that the benefits agriculture receives from the tariff are numerous and substantial. These benefits, moreover, are likely to increase, because our agriculture is moving definitely toward a situation in which many of its leading products will be on an import basis. Each year the tariff is becoming more and more effective for agricultural products. Tariff duties on farm

products prior to the war were largely hypothetical. Now, with increasing population, with relatively declining farm population, with declining farm acreage per capita, and with increasing efficiency of farming, the tariff is becoming protective for crops formerly influenced mainly by the world market. Already it has become protective for premium products, such as representative flour wheats and other superior wheats. This has the advantage of stimulating the production of premium products and discouraging the production of low-quality products. Powerful forces are carrying us into a position in which the tariff will have its intended effect in the near future on a steadily lengthening list of important farm commodities.

Some examples of direct benefit obtained by agriculture from the tariff may be of interest.

#### **Butter Imports Cut Down**

During the month of May, 1926, following an increase of the import duty on butter from 8 to 12 cents a pound, the imports of butter into the United States amounted to only 103,000 pounds, whereas in the same month last year the imports were 331,000 pounds. During June this year we imported only 100,000 pounds of butter, as compared with 579,000 pounds in the same month last year. The same story has continued in succeeding months.

The long-time trend of our trade in dairy products is definitely toward an increased net importation. The war interrupted this trend, but since 1920 it has been markedly resumed. In 1924 the net importation reached a high point equivalent to 750,000,000 pounds of milk.

Since the enactment of the emergency tariff in May, 1921, the annual average price of No. 1 dark northern spring wheat at Minneapolis has been from 16 to 27 cents a bushel above the level of No. 2 northern Manitoba at Winnipeg (two approximately comparable grades of wheat), except for a few months when our heavy 1924 crop, coupled with a light foreign crop, put us substantially on an export basis.

The United States is the heaviest single consumer of flaxseed. We import as much flaxseed and linseed oil as we produce. The import duty on flaxseed is 40 cents per bushel, which, with the drawback equivalent to some 10 cents per bushel to American crushers who reexport the cake, leaves an effective tariff of about 30 cents per bushel. The monthly average price of flaxseed during the last crop year (1925-26) ranged from 22 to 40 cents per bushel higher at Minneapolis than at Winnipeg.

Wool prices at Boston fluctuate widely relative to London prices, but during the last five years they have, on the whole, reflected fully the fact that we produce annually only about 300,000,000 pounds of wool and import annually considerably more than that amount. The case of sugar needs no illustration. Our flourishing beet industry of the West has been developed behind a protective tariff. Many other illustrations of tariff benefits to agriculture could be given.

#### **Tariff Should Fully Protect**

Under our high-tariff régime, such tariff rates should be placed on farm products, article by article, as will insure the producer the home



market. The experiences of recent years have convinced me that the system of basing tariff rates on differences in production costs is inapplicable to agricultural products. It is quite impossible to obtain trustworthy production costs, weighted either for the total crop or for the bulk of it. A certain cost of cultivation and overhead, a certain agricultural effort, may in one year be rewarded with twice the crop that is obtained in another year. Therefore, costs of cultivation can not be relied upon to indicate costs of crop units in a particular year.

In these circumstances I have little confidence in a method of tariff making for agricultural products based on supposed differences in production costs. The only method of setting up a workable and effective tariff for agricultural products is to do what used to be done decades ago for manufacturing industries, namely, to fix rates at such a height as effectively to give the home market to domestic producers.

There is little to be gained from a purely academic analysis of protectionist and free-trade theories in this connection. We have had a tariff so long that our agricultural and manufacturing industries have become as thoroughly adapted to it as they have to our conditions of soil and climate and agricultural resources. A rapid change from tariff protection to free trade would throw our entire economic life into chaos. What we need to study is how our tariff system works out in its distribution of advantages and disadvantages among various economic groups. If a tariff system is discriminatory as to various groups in our own population it should of course be modified. It is important to know, therefore, whether or not our tariff system is discriminatory, and, if so, in what direction and to what extent. Research along this line is, I think, highly desirable.

It is equally difficult to weigh the pros and cons of tariff protection by considering its effect on only a few commodities. The mere fact that the tariff law quotes a certain specific or ad valorem duty on an article does not necessarily mean that the price of that article is increased by the amount of the duty. On many articles the duty could be doubled or removed without affecting the price. This is due to conditions within the tariff wall. Pig iron and furniture, already cited, are illustrations.

#### False Method of Reckoning

Nor can one decide that the farmer loses more than he gains from the tariff merely by estimating how much more he buys than he sells under protection. This method of computation rests on the false assumption that the price of the domestic product is always increased by the full amount of the tariff. A farm organization recently figured that the annual net loss to American agriculture from the tariff, based on the years 1917 to 1921, was \$301,000,000. It estimated that the tariff in those years added \$392,000,000 to the cost of farm products to all consumers and \$1,323,000,000 to the cost of the products of all other industries to all consumers. It arrived at its estimate of the net loss to agriculture resulting from the tariff by making the wholly unwarranted assumption that the tariff was fully operative in every case.

### Data Not Broad Enough

Computations purporting to show quantitatively the extent to which farmers' gains from the tariff are offset by losses due to the burdens imposed on agriculture by the tariff on manufactured goods are invalidated, as I have already said, by lack of sufficiently trustworthy and comprehensive statistics. It is obvious that the tariff is not the only factor in the wage scales and labor costs of American industries. Allowance must also be made for the effect of restricted immigration. It is impossible, for the present at any rate, to measure separately the effect of the tariff and the effect of restricted immigration on farm costs and incomes. About all we can say with confidence is that few or no manufacturers are always able to add the amount of the tariff to the prices of their goods in the home markets. They are prevented from doing so either by domestic competition, or by the fact that consumers are generally able to protect themselves in some measure against unfair prices either by turning to substitutes for the overpriced article or by reducing their consumption of it. In the main the value of tariff protection to industry consists less in its effect on prices than in the advantage it gives in the home market. This is true of agricultural as well as of manufactured goods.

It will help us to estimate the significance of the tariff in relation to agriculture if we consider not only how it works now but how it is likely to work in the near future. There is no doubt that tariff protection is most effective on commodities produced exclusively for domestic consumption. When there is a large export surplus of any article, the price of that surplus in export trade tends to set the price for the domestic supply as well. This, of course, is a truism. Frequently, however, its full application to agriculture is overlooked. It is commonly assumed that agriculture is the only American industry operating largely in foreign markets. Manufacturing industry, with its supposed independence of world conditions, is believed to be getting the last possible ounce of benefit from the tariff, unaffected by the difficulty of disposing of its surplus.

### Need for Farm Protection Growing

This may have been largely true in the past. Even to-day industry does a smaller proportion of its business abroad than does agriculture. In the near future, however, the position may be reversed. American agriculture is moving steadily toward a position in which the home market will absorb more and more of its total production, whereas industry, on the other hand, is becoming increasingly dependent on export sales. In a comparatively short time agriculture is likely to have more need of effective tariff protection than industry.

A few figures will illustrate this significant tendency in our economic life. In 1901 our agricultural exports made up 65.2 per cent of our total exports. By 1913 the proportion had dropped to 43.6 per cent. There was an increase during the war to 50.6 per cent in 1919, but after the war the downward trend was resumed. In 1925 our agricultural exports dropped to 44.2 per cent of our total exports. In the year ended June 30, 1926, the proportion was only 40.6 per cent.

Meanwhile industry has been steadily increasing the proportion of its export trade. Alone among the great industrial nations the United States has increased the flow of its industrial exports since the war. Already we are exporting nearly 10 per cent of our manufacturing and mining output, compared with about 13 per cent of the production of our farms. Unquestionably, moreover, the volume of our industrial exports is destined to increase yet more. Industry has acquired an export surplus problem nearly as acute and difficult as that of agriculture. It is therefore less interested in the tariff than it formerly was.

#### **Tariff Should be Fair**

It would be in the highest degree unwise for farmers at this time to launch an attack on the tariff without carefully considering the possibility that in the near future they may need it more than any other economic group in the country. I have said that I can not venture a guess as to where the balance of advantage lies between agriculture and industry at this moment in regard to tariff advantages. That is a point that can only be settled by detailed expert analysis of tariff schedules and commodity prices. I firmly believe, moreover, that in every possible way the tariff should be made equitable as between agriculture and industry. Nevertheless, I am obliged to dissent strongly from the doctrine that the tariff is of no benefit to the farmer at the present time; and I am still more strongly convinced that the relative advantage of tariff protection will swing definitely to the side of agriculture, as the dependence of our farmers on foreign markets grows less and that of our industrialists becomes greater.

On this difficult, complex matter it is idle to advance dogmatic conclusions. In the absence of data showing the incidence of the tariff on articles purchased by the farmer, no estimate is possible as to what the tariff costs him. It is likewise difficult to determine what tariff protection on flax, sugar, wool, dairy products, livestock, and spring wheat is worth to him. We know enough, however, to be on safe ground in rejecting the unqualified assertion that the advantages of the tariff are all on the side of industry. I feel, too, that we have equally good warrant for feeling confident that tariff protection will be increasingly important and, indeed, indispensable to agriculture in the near future.

#### **Insure Farmers the Home Market**

What we should seek in dealing with the tariff on agricultural products is, as I have pointed out, to insure the home market, so far as possible, to the American farmer. He should have effective protection against foreign competition. As I have previously pointed out, labor to-day has, by means of the immigration laws, effective protection in this country. This is manifestly desirable. Among the chief reasons why the United States is better off than foreign countries are that labor is here paid well and that there is little unemployment. This is of direct benefit to agriculture. Even a very little reduction in food consumption per capita, which would come from lowered wages or unemployment, would speedily pile up bigger surpluses of farm products than have oppressed agriculture in recent years. Well-paid



labor is thus of advantage to agriculture as affording a large consuming market of high purchasing power.

On the other hand, there is no doubt that the price of what the farmer buys is substantially increased by high wages. The precise effect of high wages on the prices of articles which farmers buy has not been accurately measured, nor for that matter has the exact effect of the immigration laws on protection for labor. We may say with confidence, however, that these items are considerable. Prices are materially higher because labor is well paid, and a principal reason why labor is well paid is that it is effectively protected by the immigration laws.

The remedy of the farmer is not to break down the protection for labor, as this would be disastrous to agriculture, but to seek by means of the tariff the same effective protection against foreign agricultural competition that labor has secured in its field by means of restricted immigration. To this the farmer is beyond any shadow of doubt entitled.

Assured the home market, the farmer may utilize it in the same way that labor has utilized its advantage; namely, by producing with greater intelligence and skill and by bargaining collectively, as I have pointed out in discussing cooperative marketing.

### THE CROPS OF THE YEAR

It will be useful to give here a brief review of the crops of 1926 as estimated by the department in October. Cotton and fruit, as already mentioned, were large crops. There was a good crop of wheat, a relatively short crop of corn, a production below the average of oats, rye, hay, and potatoes, and a production slightly above the average of barley, flaxseed, and beans. Crop yields per acre, in spite of early frosts in the Northwest and excessive rains in the Central States, approximated the average of the last 10 years.

Following a year of heavy abandonment, the area of winter wheat abandoned in 1926 was small, and the acreage harvested nearly one-fifth greater than in 1925. Yields per acre were above average and production was over one-tenth greater than the five-year average. Spring wheat, on the other hand, was adversely affected by drought in the Dakotas, yield was below average, and production was only four-fifths of the five-year average.

The total crop of all wheat was 840,000,000 bushels (October estimate), which was 174,000,000 bushels greater than in 1925 and 38,000,000 greater than the five-year average.

The 1926 corn crop of 2,680,000,000 bushels was 6 per cent below average and was reduced in quality by relatively early frosts and by excessive rains in the North Central States. Frost damage covered a smaller area and was less severe than in either 1924 or 1917, when the corn crop was severely damaged by killing frosts. The Southwest and Eastern States had relatively good crops of corn this year.

An oats crop slightly below average was produced on a slightly increased acreage in 1926. In October the production was estimated at 1,282,000,000 bushels. Extensive field damage at the time of harvest or after harvest affected a considerable portion of the crop, and

the quality of it was materially below average. The barley crop is estimated at 197,000,000 bushels, which is slightly above the five-year average crop. Yield per acre was cut by drought and quality was lowered by rain after harvest.

The hay crop of 93,000,000 tons was 3,000,000 below the relatively short crop of 1925 and considerably below the average crop of 101,000,000 tons. Yields of clover and timothy and alfalfa were below average, particularly in the Great Plains from North Dakota to Kansas.

The 1926 cotton crop, from the indications of October 1, promised to be the largest on record. Acreage planted was the greatest ever known, and abandonment was only about average. The yield was fair to good in practically every State. Eight States this year each had a production in excess of a million bales. In 1914 and 1925, when 16,135,000 and 16,104,000, respectively, were produced, seven States each produced an excess of a million bales. In no other year have more than five States each produced more than a million bales. A late season was nearly made up by unusually warm, dry weather in September.

Flaxseed production was reduced by dry weather in the Dakotas. The crop was estimated at 19.5 million bushels, which was smaller than in 1925, but still above the five-year average.

The rye crop was less than two-thirds of average, owing largely to progressive reduction in acreage, but partly also to below-average yields.

Potato acreage was increased only moderately over the relatively small acreage of 1925. Yield per acreage was slightly above average and total production was 351,000,000 bushels. On the whole, the crop was well distributed, most surplus-producing areas having about an average quantity for shipment.

Production of sweet potatoes was 79,000,000 bushels, one-fourth greater than last year, but still slightly below an average crop.

Tobacco this year produced an average crop. Production of cigar-type tobacco was below average. Production of cigarette types was larger than average, but not above the trend of present consumptive needs. Pipe and chewing and export tobaccos were slightly below average, but for most types were somewhat above consumptive requirements.

The apple crop was estimated at 234,252,000 bushels. In only a few States was the crop exceptionally heavy, but production was above average in nearly all sections of the country, and the total crop was the largest in a dozen years.

The peach crop was large in all important States except Oklahoma. The crop of 67,242,000 bushels was about 40 per cent above the average and 5 per cent larger than the crop of 1915, which has been the record year.

The pear crop of 25,000,000 bushels was the largest on record. Grape production again exceeded slightly all previous crops.

Pastures were relatively short until the middle of August. Since that date they have improved greatly and provided unusually succulent fall feed.

Production of commercial truck crops in the aggregate was considerably below 1925, which was a year of generally good yields of these crops. Tomatoes and green peas for canning were particu-

larly short crops. On the other hand, lettuce and spinach crops were large. Commercial truck crops, including early potatoes, made a total of about 7,300,000 tons, compared to 7,600,000 tons in 1925.

### THE WHEAT SITUATION

The world market outlook for wheat this year is better than it was last year, although domestic markets are not paying as much for some classes of wheat. Higher yields in many States, however, will more than make up in returns for the reduction in price per bushel as compared with last year for the United States as a whole.

Prospects are for a world wheat crop about the same as last year. Fortunately the increase in this crop in the United States is largely offset by a reduction in the European wheat crops. Whereas the wheat crop of the United States is 174,000,000 bushels greater than last year, European countries reporting to date indicate a production of nearly 130,000,000 bushels less than last year. Recent reports indicate that the estimates of several European countries are likely to be reduced as the final outturn of the crops become better known. Reductions in other countries have amounted to about 40,000,000 bushels.

Estimates received to date from 32 countries in the Northern Hemisphere indicate a total wheat crop of 2,944,000,000 bushels as compared with 2,939,000,000 bushels produced in the same countries last year. Reports from Russia indicate a crop about the same as last year and exports probably no larger than last year. It is too early to estimate the probable outturn of the crops of the Southern Hemisphere. Reports indicate that areas seeded are somewhat larger than last year. Seedings were made under generally favorable conditions. Average yields in Argentina and Australia would result in crops slightly larger than last year.

Although reports to date indicate a world crop, outside of Russia and China, about the same as last year, the market demand for wheat from these countries is likely to be stronger than last year. An increase in the demand from the Orient may be expected on account of poor crops in parts of Manchuria and China proper. The European demand is likely to be greater on account of a considerable reduction in the production of rye and some reduction in the potato crop. The estimates for rye in 24 countries in the Northern Hemisphere reporting to date total 838,000,000 bushels, a reduction of 143,000,000 from the estimated production of these same countries last year. The extent of the reduction in the potato crops of northern Europe has not yet been estimated but it will probably be sufficient to increase the demand for wheat.

### On Export Basis

Increased production has placed all classes of wheat in the United States this year upon an export basis. Considering the several different classes of wheat separately, it seems probable that the market for durum wheat will be better than last year. The north African wheat crop, a considerable percentage of which is of hard wheat competing directly with durum in the Mediterranean markets, is smaller than last year. Although it can not be ascertained from



statistics to what extent hard-wheat production has been reduced, it may be assumed that the production of that class of wheat is at least no greater than last year. There has been a considerable reduction in the production of hard wheat in Italy, which will increase the demand for hard wheats from other countries. With no greater competition to be expected from Russia and some reduction in our own durum crop, the demand for this wheat should be stronger than last year.

The estimated production of hard red spring wheat appears to be just about equal to the amounts consumed annually in the United States. The market for this class of wheat, however, is at present approximately on an export basis, with the price at Minneapolis about the same as the price at Winnipeg. As long as supplies seem sufficient for domestic requirements our markets for this wheat will remain close to an export basis.

The effect of a shift from an import basis last year to an export basis this year is shown by the change in relation of price at Minneapolis to price at Winnipeg. The second week of September of last year, for example, the average cash close price of No. 1 Dark Northern Spring at Minneapolis was \$1.59 as compared with \$1.37 for No. 1 Northern Spring at Winnipeg, whereas, in the corresponding week of this year the price of No. 1 Dark Northern Spring at Minneapolis was only \$1.46 as compared with \$1.45 for No. 1 Northern Spring at Winnipeg.

### Exports of Wheat

From the 1925 wheat crop and carryover of old wheat on hand July 1, 1925, the United States exported 63,000,000 bushels of wheat, and flour equivalent to 45,000,000 bushels of wheat. For the manufacture of the flour exported, we imported in bond from Canada 13,000,000 bushels of wheat, and 2,000,000 bushels for domestic consumption on which duty was paid. Thus our net exports in the form of wheat, grain, and flour, amounted to the equivalent of approximately 93,000,000 bushels of wheat. In doing this, however, the accounted-for stocks of wheat were reduced by approximately 22,000,000 bushels between the beginning of the year, July 1, 1925, and the end of the year, June 30, 1926, thus reducing the exports from the 1925 production to 71,000,000 bushels of wheat and flour manufactured from domestic production. In the export statistics no distinction can be made between the new wheat and the old wheat, nor can the exports of flour be distributed by classes of wheat used in its manufacture.

The 63,000,000 bushels of wheat exported as grain may be classed about as follows:

	Millions of bushels
Hard red spring-----	10
Durum-----	21
Hard red winter-----	11
Soft red winter-----	3
White-----	18

A large part but not all of the exports of all classes except Durum was from the Pacific Coast States.

If we did not have a tariff, Canadian wheat would come over the line in greater quantities than it is now coming over, with prices as

they are now. In other words our hard spring wheat is now receiving some degree of tariff protection. Winter wheat growers likewise benefit from the tariff. This is true even when the domestic price of wheat is not above the export level. But for the tariff, much wheat from Kansas would be displaced at Buffalo by wheat from Canada.

### THE DAIRY INDUSTRY

On the whole the dairy industry has been in a fairly strong position during the last year. A favorable spread between milk and feed prices has encouraged eastern dairymen. Their view of the situation has been shown in rather high prices paid for cows. Indications are that an increasing number of heifer calves are being raised. Many cows have been slaughtered in the East in antituberculosis campaigns. Conditions have perhaps not been quite so favorable for western butter producers, butter prices having shown relatively less strength than whole-milk prices.

An element of strength in the dairy situation has been a declining rate of increase in production. There was an increase in milk production in 1925 of only 2 per cent over the amount produced the previous year, compared with an average increase of 5 per cent in the last few preceding years. In the early part of 1926 there was a tendency for butter production to resume previous yearly rates of increase. This tendency, however, fell off as the year advanced. After the flush period of summer, the lead established in output was again lost. The trend toward lower production has tended to offset the effect of large stored surpluses.

The 1926 storing season opened with a rather heavy carryover. As the season advanced there was again a tendency toward the holding of a large storage surplus, corrected in part by the downward movement of production. A high record of holdings of butter in cold storage had been reached in the fall of 1924, when 156,000,000 pounds were reported in the warehouses. This situation resulted in large part from unusually favorable weather and pasture conditions. The accumulation, however, was cleared off before the opening of the season in 1925. Holdings of butter in cold storage on September 1 for the 1925-26 season were large (128,000,000 pounds), but they were not the result of an exceptional carryover from the previous season.

### No Foreign Competition

Foreign competition has not embarrassed our dairy industry this year as it did in 1925. Toward the end of that year the foreign situation exerted a depressing influence. There was a possibility of considerable importations of butter. In fact some foreign shipments arrived in spite of an 8-cent tariff duty. Although these imports were not large enough materially to affect the home market, psychological influences due to these imports and to the possibility of others remained in evidence until a change occurred in January in the foreign situation, as a result of which the prospect of substantial importations of butter disappeared. In April the tariff on butter was increased to 12 cents. Since that time butter imports have been of no consequence in the American market.

The dairy industry is not subject to extreme ups and downs. Its turnover is slow and its market relatively stable. Dairymen therefore rarely expect large returns. On the other hand, they are seldom without a fair income. This has been abundantly demonstrated during the last five or six years of agricultural depression, during which the dairy industry has been one of the bright spots in the farming situation. Observers do not expect conditions in the near future much more advantageous than the dairy industry is now enjoying, but there is no immediate prospect of any serious setback.

### EGG PRODUCTION

Egg production during the first two months of 1926 was much above that of 1925 and prices were materially lower. From March to September 1 production held only slightly above 1925. In that period the farm price of eggs was generally well maintained, at times slightly lower than last year, at times slightly higher. All in all, to date the gross return to farmers for eggs seems to have been slightly above that of 1925, which was considered a fairly satisfactory year. Moreover, purchased feeds, except wheat products, were lower than in the preceding year.

### THE LIVESTOCK SITUATION

On the whole the livestock industry prospered this year. Hogs, sheep, and lambs sold readily at remunerative prices. Wool prices declined during the first two-thirds of the year, but toward the end of the summer strength in foreign markets was reflected in the domestic market, and wool prices advanced sharply. The finished cattle market was the least satisfactory part of the livestock situation. More high-grade, heavy-weight beef was produced during the spring and summer than the consuming market could absorb at prices profitable to the feeder. The entire livestock situation can be summed up by saying that a greater tonnage of meat was produced than in 1925, and that the total supply returned to agriculture a somewhat larger amount of money. In other words, a greater quantity of meat moved into consuming channels at a higher average price.

Although finished cattle were not profitable, cattle production as a whole moved into a stronger position. All available evidence indicated a substantial curtailment in basic supplies of beef cattle. With continued industrial activity cattle prices should respond with substantial advances to the more favorable supply position. What happened in the finished cattle market during last summer, disappointing though the experience undoubtedly was to feeders generally, tended nevertheless, to strengthen the prospects of better times. The poor demand for fed cattle was strictly a temporary episode, resulting from the price situation of 1925 plus an abundance of corn. It did not change the fact that basic supplies of beef cattle in the country were at a low ebb.

#### Improvement in Fall

There was improvement in the late summer and early fall market in 1926. In that period market receipts of cattle decreased slightly, and the prices of the better grades advanced from \$1 to \$1.50 a



hundred pounds. There were indications, in short, that the temporary market glut was over and that prices were coming more into adjustment with the potential supply of cattle in the country in relation to the probable demand. It is therefore possible to speak of the cattle industry with confidence and optimism in spite of the fact that its returns in the last year have not been wholly satisfactory. The cattle industry has been through the fire since 1920. Of all the major lines of production that were plunged into the postwar depression, cattle production suffered, perhaps, most severely. Its difficulties continued long after producers in many other lines had begun to recover. But the range country has met its trials with courageous self-reliance.

### **Cattle Inventory Reduced**

Now, we begin to see daylight ahead. The country's cattle inventory has been gradually worked back into line with peace-time requirements—a process involving hardship for many producers and requiring skillful management. Liquidation of cattle has gone far enough to assure some degree of stability for the industry as a whole. The country is sold down very much shorter on steers than on cows. The trend in the market demand is toward the younger, lighter-weight, but high-quality animal. The outlook therefore appears favorable to the cattle raiser so far as the supply is concerned; but the situation has little in it as yet to justify anything but careful, conservative procedure.

Underneath the casual figures of supply and slaughter lies a deeper story of developments in the range country. The events since the war represent only one rather harsh chapter in a longer story of readjustment. We are going through a period of profound transition in the cattle business. The old days of the uncrowded open range are gone. With their passing has gone likewise the old unreckoning, easy-going, speculative scheme of things. We have moved forward into the day of high-priced land and labor, of heavy fixed charges, of stronger competition. We see a great new marketing development, a specialized system built up about the feed lots of the Corn Belt.

### **Breathing Spell at Hand**

This changing order of things may or may not be welcome. But it must be faced. This is a good time, moreover, to face all facts and take stock of ourselves—now, when the industry is stabilizing again, when a breathing spell is at hand and a favorable period apparently ahead of us. Never, in the judgment of shrewd observers, will the cattleman of this generation have so good a time to get his house in order as within the next five to eight years.

I am an optimist on the cattle situation. The tide has turned and better times are clearly ahead. But future stability in this industry depends greatly on how we utilize these next five years. The man who sees now only an opportunity to pursue an unreckoning, exploitive system will be lucky if he escapes trouble. But for the cattleman who is determined to build up a high-grade herd, to cut his unit costs, and to get his production on a plane of real and

lasting efficiency it would seem that the opportunity of a generation lies just ahead.

One of the problems of commerce has always been to develop a common trade language, understood alike by buyer and seller. The department has worked out a set of standard market classes, grades, weight, and age groups for both cattle and beef which in all probability will be promulgated as official United States standards. We have used this system in the conduct of our market reporting service on livestock and dressed meats for the past seven years, and it seems to have given entire satisfaction.

### Western Range Problems

How to make the Western livestock industry more stable is part of the general agricultural problem of the country. No industry which uses the soil for production can be stable unless it is going to stay in the same place and unless the land that it uses is going to maintain its productiveness. Temporary land occupancy and declining range productivity have been outstanding features of western livestock production. The industry has had to move on before the settler, has grazed the open public domain on sufferance, has had to yield possession almost everywhere to those wishing the land for any other purpose, and has, broadly speaking, been confronted with a decline in the carrying power of its vast but diminishing and overcrowded ranges. Provision for permanent grazing use of such lands as will have highest value if employed in this way, for reasonable assurance to the individual stockman who is making use of the land that he will not be arbitrarily or unnecessarily dispossessed, and for insuring that lands employed for grazing will not lose their carrying power is necessary to give the range-livestock industry its fair chance at stable prosperity.

There are two possible ways to go about doing this. One of these is to let economic competition for possession of the land determine who shall have it, and enlightened self-interest solely govern the methods of use. Where the range is privately owned, this takes place. The traditional policy of the United States with respect to its public lands almost to the close of the nineteenth century assumed that private ownership was the best if not, indeed, the only way to get land rightly used. But the conservation movement brought another viewpoint. Under private ownership the right use of mountain lands, it was perceived, is not very likely to come about. Water, timber, and forage are too closely interrelated, and permanency of water and timber supplies is too important to other interests and industries to leave to chance. So some 90,000,000 acres of public lands suitable for grazing along with use for timber and water production are included in the national forests. On these lands the range livestock industry must be given a place, and its stable prosperity must be sought. But the way must be through enlightened public regulation and not by conferring of property rights to or in the land and then depending upon the play of self-interest and economic competition to determine how and by whom the land shall be used.

### New Law Sought

There is a certain degree of grazing use which these lands can be given without injury to timber growth, water flows, or the range



itself. There are certain methods of use which make possible the largest returns to the users and to the community. Only as all of these questions are worked out and worked out right can regulation stabilize the western livestock industry along sound lines.

Primarily at the instance of the western livestock industry, the enactment of a law was sought this year defining the place of grazing in national forest management and providing greater assurance for the stockmen against unnecessary changes of administrative policy or arbitrary or unfriendly exercise of administrative powers. After protracted hearings by a Senate committee and full discussion of the subject with this department, a bill was introduced which in my judgment essentially provides what will best meet the real needs of the livestock men with respect to the national forests, and also tends to facilitate sound administration of the forests in harmony with their major purposes of timber production and water conservation.

The same bill made provision for regulated use of the open public range. There are about 180,000,000 acres of unallotted and unreserved public lands of so low value that no law permitting their private acquisition has ever been liberal enough to make patenting them worth while. Of these lands about 130,000,000 acres are grazing lands. That they have to a large extent lost their original carrying capacity, that further deterioration is extensively taking place, that under present laws deterioration is bound to continue, and sooner or later to reduce the grazing to no value at all, and that there is not only the physical waste of the resource but also the further waste due to faulty coordination with other resources employed in livestock production, has been again and again pointed out. In my report of last year I expressed my conviction that the existing policy with respect to land utilization on the public domain has had much to do with the recent troubles of Western agriculture, and called attention to the agreement of opinion among interested persons and agencies that a far-reaching change in that policy is imperative. For these lands enlightened public regulation offers not only the best hope of the livestock industry for more stable conditions, but virtually the only hope. I believe that the enactment of legislation to make such regulation possible is one of the important things needing to be done for the benefit of Western agriculture, and I hope that, in such form as may be found to be most appropriate, the general purposes embodied in the bill now before Congress may be carried to conclusion.

#### LEATHER CONSERVATION

Plans for a nation-wide campaign to improve the quality of raw hides and skins used in making leather were outlined by the United States Department of Agriculture and approved at a recent conference by representatives of farmers, cattlemen, dairymen, butchers, hide dealers, tanners, and shoe manufacturers. Millions of dollars are annually lost to producers of the raw material and consumers of finished leather goods through imperfections in raw skins and hides which result from faulty skinning and curing, careless and excessive branding, and the effects of diseases and parasites.



An enormous quantity of leather is used in this country for shoes and harness, 300,000,000 pairs of shoes being bought each year at a cost of more than \$1,500,000,000. Production of a better quality of raw material for leather making would avoid serious waste.

In line with the department's plan to eliminate waste and improve the quality of raw material, an advisory committee has been appointed to work primarily on the economic aspect of the several technical problems and to enlist cordial support for the campaign. Other committees will work on the problem of grubs, insects, diseases, and branding; on the problem of skinning and curing; on classification and marketing; and on statistics.

The elimination of grubs, ticks, and other insect pests, and the prevention and cure of diseases will pay the farmer and cattlemen well in increased milk and beef production. The department has long fostered such movements as a means of increasing the profits to livestock men. The leather industry and allied interests will add the force of their publicity and educational campaigns to encourage these practices, first as a means of producing healthier and more profitable livestock, and, second, to secure a better quality of hide.

#### Loss From Cattle Grub

The loss due to the cattle grub has been estimated at from \$50,000,000 to \$100,000,000 annually, a loss which is felt by several industries. Dairymen have estimated that a reduction of 10 to 25 per cent in milk flow is often due to irritation by the grubs. The growth of young stock is retarded and their vitality is reduced through grub infestation, and cattle raisers and feeders suffer losses accordingly. Butchers and packers lose money on hides that have grub holes in them, hides with five or more holes in them being discounted, according to trade custom, 1 cent a pound. The tanning industry as a whole prefers grub-free hides. For certain uses a single hole in the hide makes it unserviceable. The grubs perforate the skin along the back of the animal, thus damaging the portion which is of the greatest value when the hide is tanned, and the extra handling of hides necessary in classifying them as to grubbiness is an economic loss.

Faulty skinning and curing are also responsible for great annual money losses, especially in those hides taken off and cured on the farm and ranch, or by town and country butchers. The department has repeatedly emphasized the fact that this condition can be remedied only by making it more profitable for these men to take more care in skinning and curing. Premiums for quality hides would be an incentive for more care. The practice of hammering down the price of a hide simply because of its "country" origin must be eliminated, if improved methods of skinning and curing are to become effective. "Flat" buying of country hides must go before general improvement can be brought about. It will be the duty of the committee on this subject to work out, through cooperation with the department and other agencies, practicable ways of improving the methods of skinning and curing in the country and to keep this information constantly before the public through the agricultural and trade press.

## SWINE PRODUCTION AND PRICES

Swine producers have enjoyed favorable conditions for the last two years. Although corn was high in price during 1925, hog prices for the most part showed compensating advances. The situation was still more favorable during the first eight months of 1926. Corn was then relatively cheap and hogs continued high. The average price of hogs slaughtered under Federal inspection during the first eight months of 1926 was 70 cents a hundred pounds higher than in 1925, and \$3.80 more than the average price for the preceding three years. This favorable price situation was partly due to light supplies of hogs. Receipts at the principal markets during the first eight months of 1926 were approximately 3,250,000 head less than in 1925, and 10,250,000 less than the record run of 1924. The run, in fact, was the lightest for these months since 1917.

From the standpoint of the swine producer, the situation was even more favorable than the figures indicate. Pork production during the first eight months of the year, in spite of the decreased slaughter, exceeded production in the first eight months of 1925 by more than 108,000,000 pounds. This was chiefly due to the fact that the average live weight of hogs slaughtered was 18 pounds per head greater than in the previous year. In other words, swine producers in 1926 marketed much more pork and obtained considerably higher average prices than in 1925.

It is, of course, impossible to discuss the hog situation without considering the corn problem. An analysis of the present relationship between corn and hog prices and of the trend in hog production indicates that swine producers can not expect to maintain indefinitely their present degree of prosperity. Indications are that hog production will be substantially larger in the next year or two and that the increased production will be accompanied by somewhat lower prices. Swine producers should carefully measure the expansion of their operations by production costs and by the prospective demand for pork and pork products. Only in that way can they bring about a balanced situation in which hog production can be kept profitable.

## CORN

During the past year the farmers in the Corn Belt have had a surplus of corn. The price received by the corn producers of the United States for the crop year 1925-26 averaged only about 70 cents a bushel, the lowest since 1921, a year of extreme depression. This price is equivalent to only 45 cents on a pre-war price basis. The immediate effect of these low prices was greatly to reduce the purchasing power of the farmers who produce corn primarily for market. On the other hand, those who had hogs to feed profited by the large corn crop, and most farmers in the Corn Belt fed hogs or cattle.

Corn is not as easily exported as are other cereals; usually less than 3 per cent of the crop finds its way to foreign markets in the form of corn, and even in years of heavy production it seldom exceeds 5 or 6 per cent. Corn is finally exported, however, in the form of pork and pork products. About 18 to 20 per cent of the pork killed under Federal inspection is exported.



The effects of a surplus corn crop are usually felt in two different ways—currently by low corn prices, and a year or two later by an increase in the production of hogs, and consequently lower hog prices. To advise a farmer to raise more hogs because corn is cheap and hogs are relatively high is bad advice, for by the time he has raised more hogs to eat cheap corn, the hogs have become cheap and the corn high. The usual reaction of Corn Belt farmers is to do this very thing. Instead of planting less corn when corn is cheap and holding hog production down to a point where hog prices are on a fairly profitable level, the tendency is to plant about the same acreage of corn the next year and increase the number of hogs.

The production of 2,905,000,000 bushels of corn in 1925 was not the largest crop on record by 300,000,000 bushels. In fact, it was only 55,000,000 bushels above the 10-year average production, and the carry over from the 1924 crop was unusually small. The difficulty was not so much with the size of the 1925 crop as it was with its geographic distribution. Ordinarily about 65 per cent of the corn crop is produced in the 12 North Central States commonly spoken of as the Corn Belt. It is from about 9 of these 12 States that most of the surplus corn of the United States is shipped from the county where grown. Most of the remaining 39 States produce less corn than they use. When they are short of corn to feed, other concentrates are substituted and less grain is fed.

#### **Increased Hog Production Likely**

It is now apparent that the abundance of corn in the Corn Belt with low prices is to be followed as usual by the production of more hogs. The pig survey of June, 1926, showed that farmers intend to materially increase their fall farrowings this year, thereby initiating the first stages of another cycle of increased hog production at a time when hog prices are not sufficiently above the level of the prices farmers pay for commodities to warrant any increase whatever. Corn acreage planted in 1926 was reduced less than 1 per cent. Although there is a larger carry over of old corn and prices are still very low, the worst of the corn surplus situation is probably passed, and it will be only a question of a year or two from this winter when a surplus of hogs will be the topic of the hour.

At this writing a corn crop for the present year of about 2,700,000,000 bushels is indicated. If this forecast is borne out, the crop will be about 7 per cent below last year's large harvest and 5 per cent below the average of the last five years. The demand for corn will probably be better this season than it was last, in view of the prospect that hog production will be increased, although exports of corn are likely to continue small. European demand for American corn has been restricted by the presence of liberal quantities of barley and oats on the European markets and also by the fact that a large surplus of corn has been available for export from Argentina. Crops of feed grains are good in Europe this year, and the competition of Argentine corn will undoubtedly continue.

#### **SHEEP**

The sheep and lamb industry continues to prosper. Expansion of the industry has been going on during the last few years. According



to the best available estimates, there were approximately 4,500,000 more sheep and lambs in the country on January 1, 1926, than at the low point of production, which was probably reached in 1922. This expansion has progressed steadily and in general has been conducted intelligently. During the process a fair proportion of each year's production seems to have been fed into the consuming market. Although, as is always true, lamb prices have fluctuated widely and sharply over short periods of time, average prices have been held at a level which has made possible sustained or increased consumption.

Market receipts of sheep and lambs during the first eight months of 1926 exceeded similar movements in 1925 by nearly a million head. Federally inspected slaughter, however, showed an increase of less than 400,000 head, the difference between these two figures being largely accounted for by increased movements of stocker and feeder animals back to the country. This tendency to relieve the pressure on the consuming market has maintained prices at a level which as a rule has compensated the producer for his efforts. The holding back of ewe lambs to increase breeding flocks has also had a tendency to keep supplies within bounds at market centers.

Early in 1926 lamb feeders were confronted with what promised to be a serious problem, arising chiefly from the fact that feeding lambs were generally heavy when put into the feed lots the autumn before and had done well during the winter. More heavyweight, fat lambs were available than the market could readily absorb at prevailing prices, and consequently the market broke rather sharply. A combination of circumstances, combined with efforts on the part of various market agencies and the Department of Agriculture, brought about a material increase in the consuming demand for lamb. Prices righted themselves to the extent that in June a sharp advance occurred, which carried top lambs well about the \$17 mark.

#### A 10 Per Cent Increase in Lamb Crop

A survey conducted by the department in June indicated an increase of about 10 per cent in the 1926 lamb crop as compared with that of a year earlier. This would seem to indicate a considerable increase in the number of lambs which will normally come to market during the latter part of the year. In all probability there will be a gradual lowering of the market price level as the effects of the expansion which has been going on during the past two years become apparent in materially increased market receipts. There seems to be little if any cause for anxiety, however, provided sheepmen conduct their operations in the light of probable future prices and costs, rather than with their attention fixed on prices which have prevailed in the past during periods of scarcity.

#### THE COTTON SITUATION

The present statistical position of cotton indicates a considerable reduction in returns to growers for the crop now being harvested. The large crop of 16,100,000 bales produced last year yielded a return to growers somewhat less than the crop of the previous year, which

amounted to only 13,600,000 bales. This year's crop, according to the October 1 forecast of 16,627,000 bales, is greater than that of last year, and stocks at the beginning of the new crop year were so much greater than at the beginning of last year that the total supply for the year is considerably larger than last year.

Prices to producers at the beginning of the season, as of August 15, averaged only 16.1 cents, compared with 23.4 cents last year, and have declined sharply since the beginning of the season. This decline in price brings the southern producers face to face with a cotton-surplus situation. Sixteen cents for cotton is equivalent to only about 11 cents per pound before the war, which is lower than the average price received for cotton in the period 1909-14. The recent low level of 12 cents is equivalent to only 8 cents before the war.

To realize the significance of this fact, it must be noted that there has been considerable increase in the cost of producing cotton on account of the boll weevil, which before the war had spread over only a part of the Cotton Belt. Last year, according to reports from 1,400 farmers in the Cotton Belt, the average cost per pound to producers of cotton lint was about 18 cents.

### Developments Not Favorable

Developments of the last year have therefore not been favorable to cotton growers. Two years ago supply and demand were nicely balanced and prices were satisfactory. Last year the final acreage harvested was increased 11 per cent over that of the year before and the season's crop exceeded the total consumption by a little more than two and a quarter million bales. This year the acreage in harvest is computed at an increase of 2.7 per cent over that finally harvested last year. Weather and insect conditions on the whole have favored the plant and another large crop has followed. This crop, estimated to be the largest ever produced in this country, is now moving to market at prices lower than those of any crop since 1921. Reliable figures on the cost of making the present crop are not yet available. There is little question, however, that present selling prices of cotton at the farm are less on the average than costs of production.

Last year's crop was notable for its unfortunately large percentage of low grades and its small proportion of high and medium grades. Opened cotton was exposed throughout much of the belt to early and prolonged rains and the damage to the quality was extensive. For a time these low grades were in little demand and could be sold only at large discounts. Fortunately, it was found under pressure of necessity, that in many of the mills certain of these lower grades could be satisfactorily substituted in part for some of the higher grades which had formerly been required.

It must be counted as fortunate under these circumstances that other conditions have favored large consumption of cotton. The world used last year, according to the best obtainable figures, some 13,800,000 bales of American-grown cotton. This is about a million bales more than were spun in the previous season and is the largest consumption recorded since the year 1915-16, when industry was striving to meet the necessities of the war. The present marketing

season which dates from August 1, 1926, finds both exports and domestic consumption running larger than they were a year ago.

### **Compensation for Future**

While on the whole the present season must be put down as an unprofitable and a disappointing one to the average individual grower, it may be possible after all to find in it some compensations for the future. By no means the least of these is the fact that the current price should and doubtless will serve to discourage the development and organization of cotton production in the newer cotton areas of the world and reduce as well the American acreage. In recent years, much effort has been put forth in other countries to establish cotton growing on a permanent basis. Although up to this time these endeavors have been notable for the rather negligible success that has rewarded them, they have suggested enough of future competition to attract some attention.

It is observed in periods of low world prices for cotton, that interest in the crop among the cotton growers of foreign countries rapidly subsides and that investment in ginning, handling, and transportation facilities necessary to the permanence of the industry is discouraged. Our crops of this year and last have dispelled much of our own fear of the menace of insects to the future of our cotton industry and stand as a demonstration to ourselves and to the world of the productive power of our Cotton States. One important effect of large supplies and low prices must inevitably be to expand the use and consumption of cotton. It is estimated that the products of cotton are now used for about 10,000 purposes. It seems reasonable to believe that at lower prices, the uses of cotton will be increased and its adaptation to new purposes encouraged.

### **Place of Cotton in Export Trade**

Cotton growing is the chief branch of agriculture in a large section of our country, and cotton is one of our great national assets, standing first in value among all of our exported commodities. The welfare of the cotton grower should therefore be guarded and fostered as a matter of wide national concern. On this view the department has continued to work. Intensive studies have been carried into the economics of the industry, with a view of learning the extent to which the consumption of our cotton may eventually go and of determining what types and varieties of cotton lie within the field of most profitable production. It has been possible to broaden and energize some of these lines of study by cooperation with southern agricultural colleges.

### **Need of Low-Cost Production**

A season of low prices enforces the lesson to the farmer of making his production of cotton as efficient and economical as possible by planting only in fields that will grow good crops at low cost and reducing other expenses by practical diversification. The high production costs are on the small crops, grown on land that should be used in other ways. It is estimated that the present volume of cotton production could be maintained on at least a third fewer acres by



intelligent application of improved methods, with an enormous saving in costs of production. Farmers who produce economically may be disappointed in their profits but may escape positive losses, even at prices that are ruinous to less competent neighbors.

The possibilities of a fundamental reform of the system of cotton production have been recognized and demonstrated by the work of the department in cooperating with communities of cotton growers that limit themselves to the production of a single variety. In such communities many improvements of production are feasible that otherwise are beyond the reach of the individual growers.

In organized one-variety communities all of the farmers are provided with select seed of pure and uniform quality. From the use of pure seed larger yields are obtained, as well as fiber of better and more uniform quality that can be sold at higher prices. Through the production of commercial quantities of uniform fiber a constructive solution of the marketing problem is made possible. In such communities improved varieties and methods are adopted, and greater skill and efficiency of production are developed. The effects of different conditions and methods of handling the crop are better understood where farmers are familiar with the behavior of one variety, instead of continually changing the varieties, mixing the seed, and depreciating the product, as in unorganized communities. Such a policy, combined with proper diversification, should be adopted in many more cotton-growing communities. Business as well as agricultural organizations would find it to their advantage to promote the movement.

### PRODUCTION OF LONG-STAPLE COTTON

The marketing of the American cotton crop begins with its planting on the farm. Production and marketing are interdependent. The better the product, the more thoroughly it fits demand, the easier it is to market. The world demands good strong cotton of the American upland type, ranging from  $\frac{7}{8}$  inch to  $1\frac{1}{8}$  inches in length of staple. We are not meeting this demand as fully as we formerly did. The production of short-staple cotton in the United States has been increasing, and the "bread-and-butter lengths"—the 1-inch,  $1\frac{1}{16}$ -inch, and  $1\frac{1}{8}$  to  $1\frac{1}{4}$  inch staples—are becoming a smaller proportion of the crop. It is estimated that more than a million bales, or about 8 per cent of the crop produced last year, consisted of cotton less than  $\frac{7}{8}$  inch in length of staple. Manifestly this is not desirable.

Economic pressure on the large cotton-consuming countries has induced them to encourage the production of medium-staple cotton in countries other than the United States. Brazil, for example, is pushing her cotton enterprises. There is, however, no need for immediate alarm over this fact. The Brazilian people need more cotton for their own use. Moreover, there is every probability of an increased demand for cotton throughout the world with the return of prosperity in Europe. At the same time it should be frankly recognized that an increase in the production of good upland cotton in foreign countries will make the production of excessively short-staple cotton in the United States less and less remunerative. Our opportunity lies in adjusting the quality as well as quantity of our

output to the world's needs. This applies to cotton just as it does to every other product.

### Quality is Important

Under modern conditions quality is exceedingly important. In every field of agriculture or industry quality goods—goods that exactly meet the public demand—can ordinarily and should bring a premium. European consumers have complained recently that there has been a falling off in strength and uniformity of American cotton—in short, that it lacks some of the quality that they want. There is a belief that the introduction of the small-boll, quick-maturing varieties, high in per cent of lint, is the main cause of the difficulty. These varieties, from the standpoint of lint percentage, may have an advantage as to yield. It is not at all certain, however, that they yield more lint per acre than varieties having a good inch staple. An example to the contrary was recently brought to light when a Southern newspaper announced that the winner of its “more cotton on fewer acres” contest had grown in excess of sixteen 500-pound bales on 5 acres of land, and that the staple of the cotton was  $1\frac{1}{8}$  inches. Furthermore, plant breeders have developed varieties of good medium staple that give yields equal to or superior to the varieties producing extra-short staple. They are also equal in earliness of maturity.

The boll weevil, against which our cotton farmers have waged so valiant a fight, need not put an end to the production of long-staple cotton. The development of new early-maturing varieties and the discovery of improved cultural methods of shortening the growing season are making it possible to produce excellent crops of long-staple cotton in the presence of the boll weevil. Indeed, there are additional reasons for growing long staples under weevil conditions. The care and precautions that are required to protect cotton against the weevil also make it possible to produce a better staple. In growing long-staple cotton the growers may find compensation for the increased cost of production or the diminished yield that may be caused by the boll weevil.

### Farmer Not Encouraged

The main reason why the less desirable varieties are grown in large quantities is that the average farmer can not sell better cotton for a better price. The principle that quality goods should bring a premium has been overlooked in cotton buying, so far as the average farmer is concerned. There is a substantial difference in value between a bale of  $\frac{3}{4}$ -inch cotton and a bale of  $1\frac{1}{8}$ -inch cotton. In the hands of a shipper this difference may be \$15 or more. Growers who sell their cotton in small lots at country markets, however, often can not obtain any better price for medium than for very short-staple cotton. Good staple and poor often sell for about the same figure, which is based upon the average quality of the cotton sold at the primary market point. Under such conditions the grower has no incentive to produce superior cotton. Indeed, the situation tends to curtail the introduction of new methods,

practices, or varieties by the farmer. When the same price is paid for good as for poor fiber at the primary markets, the progressive farmer is penalized and the short-sighted farmer is benefited.

The Department of Agriculture has done what it could to discourage the planting of varieties which yield the very short staples. But the remedy requires the attention of cotton buyers quite as much as that of cotton growers. A marketing system which penalizes the production of better varieties of cotton should obviously be modified. The only secure basis for our cotton industry is in the improvement of the product.

### Cash for Quality Necessary

There is no way to improve the product except by furnishing cash encouragement for quality. Discrimination in buying is just as important as high prices. Upland long-staple cotton brings from 30 to 60 per cent more than middling short staples. Farmers who produce the long-staple kind should in simple justice be rewarded proportionately. It is useless from the standpoint of encouraging quality production merely to get manufacturers to pay more for good fiber. The premium for superior fiber must go back to the farmers. Community production of better cotton would go forward more rapidly if farmers were sure of better markets for good cotton than for short fiber. It is in the interest of the cotton trade to give them this assurance.

### THE PRINCIPAL FRUITS AND VEGETABLES

Bumper crops of nearly all fruits were the rule this year, with quality very good. In October it appeared that the commercial apple crop would amount to 38,500,000 barrels, the heaviest commercial production on record. Western States were expected to have the equivalent of some 14,600,000 barrels, or about 1,000,000 more than the year before, while Eastern and Midwestern producing sections seemed to have about 23,900,000 barrels, an increase of 4,900,000 over the 1925 crop. Record crops were anticipated in the leading States, Washington and New York. Wide distribution was being given the apple shipments.

The peach crop was estimate in October at around 67,000,000 bushels, slightly above the previous highest record established in 1915. Production was about 44 per cent greater than the 1925 crop and than the average for the last five years. Georgia growers had difficulty in obtaining average returns above the cost of production and preparing the crop for market. Shipments from that State reached the unprecedented total of 17,500 cars. California canneries put up a record pack of this fruit.

The pear crop of 25,000,000 bushels was far above average and at least 25 per cent heavier than the year before. Grapes were expected to break all previous records, with a total of 2,360,000 tons. More than the usual quantity of the California product was dried. Not only was the California crop vastly increased, but eastern grapes came back with a heavy yield after the short production of 1925. The Ozark grape region is becoming of commercial importance.



Potatoes did somewhat better than last year, but a total crop of 351,000,000 bushels, as indicated in October, would still be 45,000,000 less than the five-year average and 74,000,000 bushels below the exceptionally large crop of 1924. Per capita production appeared to be around 3 bushels, which is below normal requirements. Acreage was increased only about 2 per cent, and average yields of 108 bushels would be very little better than the average for the five years, 1921-1925. The midseason potato supply was heavier than in 1925, when drought reduced the crop, causing this year's prices for a few weeks to be lower than those of the preceding season. It is hardly expected that the extremely high returns of 1925-26 will be repeated this season, even though the main crop is moderate.

#### Sweet-Potato Production Greater

Sweet potatoes were coming back to normal after several years of light production. October estimates indicated 79,000,000 bushels, which would be a crop of little above midway between that of 1925 and the five-year average of 84,000,000 bushels. Improvement was noted in practically all the States which lead in the production of sweet potatoes.

More main-crop onions and cabbage were being produced than the year before. Midseason cabbage and onions, however, found a very dull market, partly because of the abundance of home-grown supplies. Melons were a good crop, but prices were unusually low. Cantaloupes produced well except in California, and such truck crops as lettuce and celery were increased. It is questionable whether greater production of lettuce can be marketed with a profit to growers. Car-lot movement of 38 fruits and vegetables during the calendar year 1925 filled about 980,000 cars.

#### FOREIGN MARKETS

Foreign demand for some of our agricultural products was stronger in the fiscal year 1925-26 than in the preceding year, while for other products it was somewhat slack. The value of the exports of agricultural products, excluding forest products, was 17 per cent less than for the previous year but remained larger than in any other year since 1920-21. On the basis of 1909-1913 prices, the volume of agricultural exports declined 20 per cent.

The agricultural share of our exports of the last fiscal year was the lowest in our history except in the war years 1916-1918. In value the exports of agricultural products exclusive of forest products amounted to somewhat less than 41 per cent of all exports, compared with 48 per cent last year and 32 per cent in 1916-17, the lowest previous record.

The reduction in volume of exports in the past year was due largely to a short wheat crop and to a greatly reduced production of pork. Our wheat crop was so small that our exportable surplus was greatly reduced. Large crops of feed grain in Europe and cheap corn from Argentina reduced the demand for our feed crops so much that we exported only 23,000,000 bushels of corn, at an average value of 92 cents a bushel, out of a very large crop.

Having reached the low point in a hog-production cycle, our exportable surplus of pork products was likewise considerably reduced. The exports of bacon and ham from the United States declined considerably in volume but the value of the shipments was fairly well maintained. Declines were registered in the exports to practically every important market and particularly in the shipments to the United Kingdom. Lard exports also showed marked declines. Shipments to all important European markets fell off, but Latin-American countries, which are assuming more importance in our lard trade, all took larger quantities except Cuba.

The demand for cotton was not so good as last year. The exports were 227,000 bales less at a price so much lower that the value of our exports of cotton was only \$918,000,000 compared with \$1,061,000,000 the previous year. Had Japan not come into the market and taken a much larger quantity than usual, there would have been a considerably larger reduction in foreign takings. Depressed economic conditions and a weak export market for cotton goods considerably reduced the demand in the United Kingdom and Germany.

#### More Tobacco Exported

More tobacco was exported from the United States at higher prices last year than in 1924-25. The increase in the volume and value of the exports of bright flue-cured tobacco, the principal cigarette type, was particularly noteworthy. This type last year made up over 60 per cent of the total exports of leaf tobacco. The United Kingdom continues to be the leading market for American leaf tobacco, taking 35 per cent of the shipments from this country last year, while China was the next largest market taking 18 per cent. The increase in the shipments of cigarette types of tobacco to China is the feature of the United States exports of tobacco.

Fruit constitutes the only important class of agricultural products, outside of tobacco, to show any appreciable increase in exports during 1925-26 over the preceding year. The total value of the fruit exports, including fresh, dried, and canned, was \$105,000,000 last year as compared with \$85,000,000 in 1924-25.

In spite of unfavorable conditions in the United Kingdom, the principal market, the exports of apples from the United States showed an appreciable increase over the preceding year. This increase in volume and value of exports seems more remarkable considering the fact that in England there was a large amount of publicity charging excessive arsenic spray residue on American apples. This accomplishment in the face of agitation against American apples must be attributable in part at least to the diligent work of the department's representatives in the principal European markets. By keeping in touch with the market and keeping European importers informed concerning American supplies they were able to minimize the agitation against American apples. They were able at the same time to convey to American growers' organizations and exporters the critical necessity of taking double precautions to ship clean fruit abroad.

#### German Market Improved

Market conditions in general are improving in Germany and the immediate outlook for raw cotton and foodstuffs is better than it



has been at any time since the war. The improvement in the German market for dairy products is a very important factor in the world's dairy markets. In the past year Germany has taken, and is continuing to take, large quantities of Danish and Siberian butter. This has been an important factor in keeping foreign butter from our markets. Denmark is finding a better market in Germany near at hand than in New York after transportation and duty. Australia, New Zealand, and Argentina are finding outlets in England for their butter, at prices better than they could receive in New York after paying the duty, because British markets are being relieved of considerable amounts of Danish butter which has gone to Germany.

Conditions of foreign demand in other countries are in general about the same as last year. England is still experiencing a depression on account of the coal strike. Recovery of general prosperity and purchasing capacity will necessarily be slow. Economic conditions in France, Italy, and many of the smaller countries are unsettled. Efforts of the Governments in France, Italy, and Belgium to strengthen the currencies, if successful, may be expected to improve prosperity in the future, but may result in a temporary check upon business activity, and hence a temporary restriction upon those markets for American raw cotton and foodstuffs.

### Larger Exports

The United States is producing this year larger exportable surpluses of wheat, cotton, and apples. Whereas last year our net exports of wheat, including flour, amounted to only 93,000,000 bushels, we are likely to have available for export this year nearly 200,000,000 bushels of wheat. We need foreign markets for a considerable part of the increase of 27,000,000 bushels in our commercial apple crop, as also for the increase of more than a million bales in our cotton crop. Fortunately for our farmers, Europe exclusive of Russia, according to latest estimates, is harvesting a wheat crop 140,000,000 bushels less than last year and a rye crop 131,000,000 bushels less than last year. The north African wheat crop is also 14,000,000 bushels less than it was last year. It seems, therefore, that the foreign demand for our wheat will be better than it was last year. Although favorable conditions in the Southern Hemisphere to date indicate possibly greater competition from that source, we ought to be able to dispose of our exportable surplus of wheat without depressing the world wheat market.

Some reduction in apple production in northern and northwestern Europe has left a market for more of our apples. Reports to date indicate that the foreign production of cotton may be less this year than last, but not sufficiently less to effect a material increase in the demand for our cotton. In fact, we produce such a large proportion of the world's crop that the size of our crop practically dominates the world market.

Prospects for European markets for corn, oats, and barley as feed grains are not so good as last year. Europe has harvested a large crop of oats and is harvesting a fairly good corn crop. Adding the three crops together, the present prospects are that Europe exclusive of Russia will have an increase of at least 5 per cent in the tonnage



of these crops. Argentina is planting a new corn crop and it is too early to determine how much competition one may expect in the European markets from this source. The crop that was harvested there last April and May was the largest that that country had produced since 1914, and some of that crop will compete with this fall's United States crop in European markets.

### **Pork Production Stimulated**

Larger feed-grain crops and consequently lower prices will undoubtedly stimulate an increase in pork production in Europe just as last year's large crop is inducing farmers to plan to produce more hogs in the United States next year. Conditions for marketing our pork products in Europe should remain favorable for a short time, but increased pork production in this country is likely to be met by increased competition in foreign markets.

The total foreign trade of the United States in dairy products has been declining since the abnormal trade of the war period, in spite of a steady increase in domestic production. Figures for the year ended June 30, 1926, indicate a continuance of that decline and also illustrate the tendency of imports into the United States to exceed exports by an increasing margin. This situation, however, is always open to the possibility of being reversed with the acceleration of the tendency toward increases in domestic production. While world production since the war has increased continuously up to the record year of 1925, demand during that year and in 1926 has been sufficiently well sustained to keep world prices of dairy products at relatively high levels.

In general it may be said that there is no immediate prospect of a weakening in foreign competition in agricultural production. Production in Europe is steadily recovering from the effects of the war, while expansion in Australia, Argentina, and Canada continues.

### **OUTLOOK REPORTS**

A demand among farmers for more complete and up-to-date economic information led the Department of Agriculture in 1923 to begin preparing and issuing statements on the outlook for the production and marketing of the principal commodities. These reports met with such a favorable reception that the work has been expanded and made a regular part of the program of the department.

In February of each year a comprehensive report is prepared covering the outlook for all the commodities on which sufficient information is available. During the summer of each year special reports on the outlook for hogs, sheep, and cattle are prepared and a report on the outlook for wheat production is issued just prior to the time of planting winter wheat. The general report on the agricultural outlook for 1926, issued in February, contained statements on 31 different commodities, in addition to statements on the domestic and foreign demand situation, agricultural credit, and farm labor and equipment. This report covered a greater number of commodities than any of the reports that had been issued up to that time.

Necessarily, the outlook reports present a national point of view. They should be carefully considered by producers in every region to determine whether the general suggestions given apply to a greater or lesser extent to that region. In making his plans each farmer must bear in mind not only the probable conditions of the market and the prices he may expect for his product, but also the possible lines of production in which he may safely engage considering the conditions under which he is farming and the characteristics of his own farm. Both the requirements for production and the probable returns from the product should be considered in making decisions as to what to produce and how much to produce.

### **Blanket Recommendations Useless**

Since conditions vary widely in different parts of the country, no blanket recommendation applicable to all the producers of a given commodity can be made in statements which present the national point of view. If the outlook for the production of some commodity is good, it does not necessarily follow that all the producers of that commodity would profit by increasing their production. Neither does it follow that it would pay all the producers of a particular commodity to curtail their production when the outlook is for a lower demand or increased supplies from foreign countries.

For this reason many of the State colleges, through their experiment stations and extension services have adopted the plan of preparing and issuing statements for farmers within their field. These statements are based in part on the department's report and in part on the possibilities of producing the different commodities within the State concerned.

Twelve of the State colleges sent representatives to Washington in February of this year to be present at the time the annual outlook statements were being prepared in the department. These State representatives thus became thoroughly acquainted with all the information which formed the basis for the outlook statements and were in position to prepare localized statements more directly applicable to the conditions within their States. It is hoped that all of the State colleges will be in position to send representatives to Washington to be present at the time of the preparation of the outlook reports for 1927 and subsequent years.

### **Reports Widely Distributed**

The general reports of the department and the more localized reports of the State colleges are made available to producers by all known means of dissemination. Two hundred thousand copies of the report on the outlook for 1926 were mailed direct to farmer correspondents of the department within 10 days after completion of the report. Advance copies were sent to all of the farm papers in the country and condensed statements were furnished to the press and transmitted over the radio. The extension forces of the State colleges disseminate the information through their publications and through local meetings of farmers, at which the reports are presented and their application to the particular locality discussed. These reports have been of great value to cooperative marketing



associations. Many of these associations have been active in disseminating the reports among their members.

The general outlook report issued in February is followed by a report on farmers' intentions to plant spring crops. This information gives producers an opportunity to make adjustments in their plans should there be a tendency to overplant or underplant particular crops. A report on intentions to plant fall crops is issued in August. Frequent surveys of breeding intentions with regard to specific classes of livestock are giving producers more information upon which to base their plans.

#### Outlook Crop Forecasts Accurate

Considering the recent development of this work and the lack of complete information on many points that must be considered, the conclusions presented in the outlook statements have been remarkably accurate. In even the earliest reports nearly 90 per cent of the outlook statements on individual commodities turned out to be correct, and in the 1925 report and the 1926 report subsequent events proved that more than 95 per cent of the statements were correct.

It is the intention of the department to expand this work so as to cover a larger number of commodities, to concentrate on the collection of more economic information and further analysis of statistical data needed to furnish a better basis for subsequent reports, to obtain wide dissemination of the reports, and to assist the State colleges in every way possible in preparing and disseminating localized statements that apply especially to the farmers in different areas and regions.

#### AGRICULTURAL READJUSTMENTS

Because of continually shifting conditions with respect to the production of and demand for particular commodities, careful studies are made by the department as a basis for assisting farmers in interpreting the significance of these changes. During the last year numerous studies have been conducted in Louisiana, southern Mississippi, New Hampshire, Kansas, and Idaho with a view to providing local farmers with a more adequate basis upon which to plan their production and marketing programs. In all of these studies attention is given to the adjustment of farming to meet the needs of local markets in order that emphasis may be placed upon those lines of production which are more profitable than others. Markets outside the area studied are also considered, and the necessity of keeping production in line with market requirements as to quality and quantity is pointed out.

A study in Louisiana and southern Mississippi brought out the fact that the agriculture of the New Orleans trade territory is now in a transitory stage of development away from highly specialized cotton, sugar-cane, and rice plantations. This transition is of necessity slow but it is enabling small farms to be better able to withstand depressions. The survey also indicated that a profitable increase of cotton production would result from a greater use of the richer delta and bottom lands for the crop and the use of some of the worn-out hill lands of the State for reforestation and grazing purposes. It was shown that there is need for considerable improvement in cotton-



marketing methods. Market facilities for handling fruits and vegetables produced on farms in the region studied are inadequate, and this situation, together with insufficient market news, is responsible in part for the failure of local farmers to produce a larger portion of the food products consumed in New Orleans.

In a similar study for New Hampshire it was found that local producers could profitably expand the production of some commodities, such as potatoes, provided they were grown in acreages sufficiently large to make the use of efficient machinery and production methods possible. The possibility of producing more commodities for the use of the summer hotel and tourist trade was pointed out. In cooperation with local agencies, similar studies have been made in other States. A study of dairy farming in the Shenandoah Valley of Virginia emphasized the fact that the incomes of dairy farmers in that area can be materially increased by keeping cows with more dairy blood, by feeding better-balanced rations, and by modifying cropping systems so as to produce the roughages needed by dairy cows and increase the crop production per acre without additional expense. I need not emphasize the value of such studies in revealing neglected opportunities.

### THE PEACH INDUSTRY

One of the most difficult problems in adjusting agricultural production is involved in planting tree fruits. In order to put before producers of the country the facts regarding bearing and nonbearing trees, commercial varieties, competitive districts, price trends, and costs of production, the department with the cooperation of State agencies recently made a survey of the commercial fresh-peach industry of the United States. This study included 26 different States, and reports as to the age and variety of peach trees in commercial orchards were received from about 21,700 growers located in all the important producing regions.

In 22 commercial peach-producing areas in 12 States the cost of developing peach orchards by the usual methods followed was determined. The costs of producing peaches and the usual methods and practices in producing peaches in most of the areas were also ascertained. The selection of proper varieties was found to be an essential factor in the development of a successful commercial peach orchard. Costly mistakes have frequently been made by growers in planting varieties which were not adapted to their market conditions. In some instances it has been found advisable to remove or top-work trees because the variety was proving unprofitable.

While many varieties of peaches are grown for marketing as fresh fruit, only a relatively small number of these were found to be of widespread commercial importance. The Elberta, by far the most important variety east of the Rocky Mountains, is grown in practically all commercial districts. Other varieties which are of commercial importance as fresh fruit are Carman, Hiley, and Belle. These mature earlier in the season than the Elberta. Parts of the information obtained in this study have been used by several States in preparing State publications on this subject. This study of the peach industry brings out conclusively the necessity for peach producers to make preparations for disposing of an increased production of peaches during the next few years.

## MARKET NEWS

Use of market news economic information by extension workers continues to grow rapidly. More than a dozen States now have well-organized economic services, to which the department supplies a large volume of fundamental information. The demand from the news press, farm papers, farm organizations, and radio-broadcasting services has likewise increased.

The department's 7,500 miles of leased telegraph wires is the chief means of transmitting information between the various branch offices to Washington and from one branch office to another. This information includes shipment reports, arrival and price data, and statements regarding local conditions in producing sections and terminal markets, and other valuable facts. The information is compiled and given wide publicity from Washington and the branch offices and field stations by means of mimeograph reports, radio, telegraph, telephone, bulletin boards, and the press. The products covered by daily telegraphic reports include 34 of the most important fruit and vegetable crops of the United States.

On fruits and vegetables alone the total number of mimeographed market reports distributed during the year from Washington and the branch offices was approximately 12,150,000—an increase of 12 per cent over the preceding year. A constantly augmented demand for these reports as a basis for settling railroad claims testifies to their accuracy. The mimeographed reports also furnish a basis for statistical studies and research work. Many dealers and shippers maintain complete files of the reports for reference.

In providing market news on livestock 16 branch offices are maintained. At the close of the year preliminary arrangements had been made for opening 6 new offices, made possible by an increase in the appropriations at the last session of Congress. These offices will be located at Buffalo, Cleveland, Pittsburgh, Cincinnati, Indianapolis, and St. Joseph. They will enable the department to serve a large group which heretofore has been served only partially and indirectly.

## Scope of Service Widened

Approximately 5,000,000 mimeographed reports dealing with market news on livestock were distributed during the year to subscribers in all parts of the United States and in a number of foreign countries. This represents a material increase over the distribution of such reports in the preceding year despite the fact that market reports are broadcast by radio and disseminated by other agencies. Everything is done to keep the mailing lists at a minimum. Daily wool-market reports are distributed to the press, and to cooperative associations and other interests which give the reports distribution through their own publications.

The grain and hay market news service has been made more effective by timely compilation of the market statistics necessary for the proper understanding and interpretation of the constantly changing conditions in the grain and hay markets. Contacts for the collection of market information have been extended so as to cover all of the important United States markets. Probably the most important of these reports received are those giving a summary of the



week's developments in the grain and hay markets. These are forwarded from all markets by telegraph on Friday and used in the preparation of the weekly grain and hay market reviews issued each Saturday morning. At the close of the fiscal year ending June 30, more than 300 newspapers with a total circulation of over 5,000,000 were publishing the reviews regularly.

### PRESS SERVICE

New information on the science and economics of agriculture is continually being gathered by the department through research and study in field and laboratory. Such knowledge would be of little value to the public were it not made available for wide practical use. Early and wide dissemination of agricultural news is facilitated by the department's press service, in the Office of Information, which maintains "open house" to all press representatives, editors, and contributors to all kinds of publications using agricultural information. This results in reaching practically all of the 22,000 or more publications—daily newspapers, weekly and semiweekly newspapers, farm journals, trade and technical magazines, and miscellaneous publications—in the United States, and in ultimately reaching millions of readers. Serving the wants of the writers who call at the press service headquarters results in the featuring of much agricultural information in articles of length and comprehensiveness, many of them illustrated.

Information of strictly a news nature, relating to the agricultural situation, regulatory measures, or scientific developments, is made immediately available through the department's press service to some 200 press representatives in Washington, and also is mailed in mimeographed form to all interested publications. Stories of this kind for the year totaled more than 800. In addition, there were 110 restricted or exclusive releases, some of them prepared in response to special requests from editors and contributors to the press.

Supplementing the news releases is the printed weekly "Clip Sheet," which carries stories of timely information on agricultural practices, progress of research projects, and other news of department activities. This service is mailed to more than 12,000 publications serving a large circulation, most of which is rural. More than 250 special stories of like nature, with photographs, were prepared for syndicate services supplying a large number of papers.

### College Editors Help

Particularly satisfactory results have come from the maintenance of close contact with the agricultural college editors who, through the use of much department material in their State releases, have spread information on the department's work.

Toward the end of the fiscal year a special information service was begun for country weeklies under the title, "Page, line, and paragraph." It consists of useful and seasonal information on agriculture and home making in articles varying in length from one line to a typewritten page. It goes each week to 7,000 weekly newspapers. That this service is well received and fills a long-felt need



is shown by the large number of commendatory letters received from editors and clippings from papers sent to the press service.

Agricultural news is regarded by the press as of increasing importance, and more and more space is being devoted to it. This is a healthy sign. The steady appetite for material on the department's work is indicated by the number of clippings taken from newspapers, farm journals, general magazines, and trade publications, only about 600 of which are sent to the press service. The number of clippings of all kinds runs usually from 2,500 to 3,000 a month, and has gone as high as 4,000.

## RADIO

Early in 1926 the number of rural radio sets in the United States reached nearly 1,000,000. To furnish the users of these sets with timely agricultural information, the department has inaugurated a comprehensive radio program covering the full range of its activities. A new section in the Office of Information, known as the radio service, has been established to originate programs; to make contracts with commercial stations as an outlet for these programs; and to adapt timely subject matter for radio presentation. Ninety broadcasting stations, representing every section of the country, lend their facilities regularly to the department for an average of half an hour daily.

The department's farm programs are brief digests of the most timely, pertinent facts woven into story form, and covering a wide range of topics. The fall and winter broadcasting schedule of the radio service includes 20 special program features each week. The United States Radio Farm School, which has already brought requests for a half million enrollment cards, is conducted from 25 stations. Lessons take the form of experience talks and imaginary inspection tours. Radio "schoolmasters" at the different stations conduct the classes. All lesson material is dramatized so as to catch and hold the interest of the listeners. Printed lessons are mailed to all enrolled students.

Another outstanding service, released from 50 stations, is called "Noonday Flashes." This program enables a million farmers to listen in daily on a conversation between a county agent and a farmer who discuss current problems. "Aunt Sammy," a new radio friend and neighbor for the 5,000,000 farm women of the Nation who have an opportunity to tune in, is heard from 40 stations. The service known as the "Housekeepers' Chat" is a 15-minute period devoted five days a week exclusively to up-to-date information on subjects of interest to women.

## New Farm Features

Special farm features scheduled for the 1926-27 season from 50 stations include "A Weekly Letter to Dad," which a son at college writes home telling about his studies in agriculture; "Autobiographies of Infamous Bugs and Rodents," a 10-minute specialty about "Pests that Are Bothering Now," as told by the insects and rodents themselves; "Chats by the Weather Man;" "Primer for Town Farmers;" "An Interview with the Agricultural Economist"; and a weekly "Farm News Digest."

Services through the various offices of the Bureau of Agricultural Economics to radio broadcasting stations have been maintained and expanded. The outstanding development of the radio market news service during the year is the extension of a leased wire to station KFKX at Hastings, Nebr. This powerful station will carry marketing information to the Great Plains States, into many sections not heretofore reached by the Government service. Congress provided for extensions of leased-wire service through the agricultural college at Ames, where reports are broadcast by the college station. A "drop" has been opened at Oklahoma City where, through cooperation with the State board of agriculture, reports are broadcast for the Southwest. With the development of more college and university radio stations additional contacts have been made for the use of market material. Marketing information is now being used by stations at Ohio State University, Columbus; Purdue University, Lafayette, Ind.; and the South Dakota station at Brookings.

### WORLD CROP AND MARKET INFORMATION

An increasing demand for the latest information regarding crops in the world's chief producing countries and market conditions in our important foreign markets is evidenced by the many direct requests made of the department's foreign service. The rapidly increasing use of economic information by farmers and by cooperatives, merchants, and other agencies of the farmer in the process of producing and marketing the Nation's supply of farm products indicates a growing understanding of the close relation that exists between the agriculture of the United States and the production and market requirements of foreign countries.

Foreign competition and demand must be taken into account both in planning production and in marketing farm products. In recent years approximately 13 per cent of the net product of the agriculture of the United States has been marketed in foreign countries. Considering only that part of the production that is sold off the farm, over 16 per cent has been sent to foreign countries. Approximately 50 per cent of the cotton crop must find a market abroad annually, facing increasing competition from Brazil, India, China, and new cotton-growing regions in both South America and Africa. Last year nearly one-third of the wheat crop was sold in foreign markets. Producers of pork, tobacco, and apples, three other great industries, have to depend to a considerable extent upon foreign markets for an outlet. Prices received by farmers for all these products depend not only upon the production in the United States and foreign countries but also upon foreign market requirements as to quality and quantity, and the purchasing power of foreign consumers.

### FOREIGN COMPETITION IN UNITED STATES

The producers of many farm products have to meet foreign competition in our own markets. The United States imported agricultural products, exclusive of forest products, valued at \$1,918,000,000 in the year ending June 30, 1926. Many of these imports compete directly with American-grown products—for example:



Sugar \$232,000,000, wool and mohair \$125,000,000, hides and skins \$94,000,000, tobacco \$60,000,000, dairy products \$31,000,000, and flaxseed and flaxseed oil \$40,000,000. The farmers who have to market their products in competition with these imports are vitally concerned with production and prospects of production of these products in foreign countries as well as the foreign demand which is an important factor in determining at what price these products will be offered in the United States.

The department is developing a world crop and market reporting service that is furnishing producers with timely and helpful information. With the assistance of the International Institute of Agriculture, American consuls, Department of Commerce agents, and representatives of the Department of Agriculture in Berlin and London, and Italy, information is being collected as to production in all parts of the world and a beginning has been made in reporting market conditions in foreign countries. Reports of prices and market conditions in British and continental markets for our apples, wheat, cotton, tobacco, pork, and other products are received daily by cable and radio from foreign countries, and the information after careful interpretation is broadcast by leased wire, radio, and other channels of the department. Mailing lists arranged by commodities are maintained, to which a special release service is provided. "Foreign Crops and Markets" is being widely reprinted by trade journals, newspapers, farm papers, and farmers' cooperative marketing organs.

Another important step in bringing American producers and European consumers together has been taken in sending a well-trained fruit-marketing specialist to study European fruit markets for apples and citrus fruit. This survey of European fruit markets has brought to the attention of producers and shippers in this country many ways in which the European market requirements can be better met. Reports on these markets are helping to avoid much waste from shipping the fruit too green, not suitably packed for the ocean voyage, not put up in a manner to attract foreign buyers, varieties not suited to the market, sizes too large or too small, or in such great quantities as to overload weak markets.

Without additional personnel or increased expenditure, in the past year the department has increased greatly its foreign service. This has come about largely as a result of the natural development of the organization and through the more effective assistance of the cooperating agencies, the Consular Service, the Bureau of Foreign and Domestic Commerce, and the International Institute of Agriculture. The increasing and systematic use of data relating to foreign production and market possibilities is taking an important place in planning our farm adjustment and marketing program. The many special requests from producer interests for work in analyzing and developing foreign markets which are received in the department indicate the need for expansion of this service.

#### GRADING OF FRUITS AND VEGETABLES

Rapid progress has been made in the standardization of grades for fruits and vegetables during the last year. Grades have now been recommended for 35 different fruits and vegetables. The use



of national grades for fruits and vegetables has been extended through their adoption as official standards by the States. Thirty States have now officially adopted one or more of the United States grades. In many cases the use of these grades is compulsory for those crops standardized under the provision of the State law.

Great progress has been made during the four years that the shipping-point inspection service has been in operation in securing the adoption of recognized standards for fruits and vegetables. Supervising inspectors have reported better knowledge on the part of shippers of established standards and more effort to comply with the best grading practices. Insistence by several organizations on the shipment of graded products only has kept on the farms products of low quality which otherwise would have gone on the market in competition with the higher quality offered by the better growers and shippers. The inspection service has also helped cooperative associations in dealing fairly with their members.

Rice standardization investigations for the purpose of perfecting the United States grades for milled rice and for rough rice were continued. Improved standards for these commodities are being developed. A detailed study of California rice and of rice grading, handling, and marketing conditions is being made.

#### Rice-Grading Schools

In cooperation with extension leaders in the Southern States rice-grading schools have been conducted in the principal rice centers of Arkansas and Louisiana. At these schools rice-grading demonstrations were made, and moving-pictures and lantern-slide lectures pertaining to rice grading and to improved methods of handling rice were given. As a result, the Arkansas Cooperative Rice Growers' Association installed a complete rice-inspection laboratory and several rice mills installed new rice-testing equipment.

A mechanical device, known commercially as the Smith shelling device, for removing the hulls from samples of rough rice for testing and grading purposes has been perfected by the department. By use of this device it is now possible to determine the milling yields and qualities of rough rice, and also the percentage amounts of red rice and damaged and chalky kernels in rough rice. This makes uniform and accurate grading of rough rice possible. The device is in regular use for commercial inspection purposes by one of the principal rice-growers' cooperative associations.

Official standards for shelled corn, wheat, oats, rye, and grain sorghums were in effect during the entire fiscal year. Official standards for feed oats and mixed feed oats became effective September 1, 1925. In addition, official standards for barley were promulgated on May 26, 1926, to become effective August 24, 1926.

Requests have been received from many sources, including the governors of North Dakota, South Dakota, Montana, and Minnesota, for a complete Federal service in testing of wheat for protein content. Further legislative authority will be necessary, however, before these requests can be met.

No changes or modifications of existing standards or grades for American upland cotton were made during the fiscal year, but five standards for upland cotton of extra white color were promulgated

at the urgent request of producers and handlers in the irrigated sections of the Southwest whose cotton was not readily classified by existing standards. These standards become effective August 1, 1927, but prior to that date they may be used as tentative or permissive standards.

Seventeen States in which hay production or consumption is of importance had adopted United States hay standards as official State standards at the close of the year. Other important hay States are now giving serious consideration to the adoption of the standards. In 39 States agricultural colleges are employing United States hay standards in the teaching of hay grading and field crops to students of agriculture.

### Standards for Soy Beans

New standards for soy beans under a joint Federal-State inspection service in North Carolina proved their practicability and value. Assistance was given to cooperative egg-marketing associations in Ohio and Nebraska in establishing grades for their market eggs. In each case the United States standards and grades for eggs were adopted. The results obtained indicate that the United States grades are practical and especially well adapted for use by cooperative organizations in handling and marketing graded eggs. The United States grades for eggs were demonstrated in Nevada, California, Oregon, Washington, Utah, Montana, Nebraska, Kansas, Missouri, Illinois, Indiana, Ohio, Michigan, and Alabama.

After extensive study, numerous conferences with the trade, and a thorough test in market reporting, grade descriptions for market classes and grades of slaughter, feeder, and stocker cattle were prepared for publication. Tentative grade standards for these classes were formulated and submitted in connection with the proposed standards for beef grades at public hearings held at Portland, Oreg., Chicago, and New York City. Progress was made also in drafting specifications for grades of calves and vealers and sheep and lambs.

In cooperation with several of the State agricultural experiment stations, a study was begun to determine, among other things, what makes quality in beef. Approximately 1,000 cattle fed by the experiment stations were graded as feeders, later as slaughter cattle, and afterwards as carcasses of beef. Finally cooking tests were made and the cooked meat graded by experts. In connection with these experiments standard grading charts were devised by which it is possible to apply a mathematical weighting to each grade factor, thereby facilitating scoring and making more accurate grade comparisons. The results so far indicate a rather close correlation between the grade of the live animal and the grade of the carcass.

After eight years' practical use in market reporting and three years' use as suggested standards in commercial transactions, standards for grades of carcass beef were formally promulgated June 3 as official United States standards, effective July 1, 1926. These standards provide for seven grades each of steer and heifer beef and six grades each of cow, stag, and bull beef. Interest in standardization is very active among livestock producers.



### Tobacco Classifications

A classification by types of all American-grown tobacco was made. This classification has met a distinct need not only of the producer but of the tobacco trade as well.

Twenty-nine distinct types of American tobacco are recognized. Grades have been prepared for all the leading types with the exception of Burley. Study was given to this type, however, and at an early date tentative grades for Burley tobacco will be issued. A special report has been prepared on the sizing of tobacco, which may finally result in the use of a common sizing system for American-grown tobacco, not only in the United States but also in foreign countries.

### Barley Standards

The preparation and establishment of standards for barley presented a difficult problem by reason of the difference in conditions obtaining in the Middle West as compared with the Pacific coast area. Public hearings were held at several of the important barley markets at which producers, dealers, and all other branches of the industry were afforded opportunity to present their views. Following this, official standards were established, divided into classes on the basis of the section where grown. These standards became effective August 24, 1926, and it is believed that they will work out satisfactorily to all interested parties.

## INSPECTION OF FRUITS AND VEGETABLES

The service covering the inspection of fruits and vegetables and the certification as to their quality and condition has made satisfactory progress both at shipping points and at the receiving markets. The total number of inspections of fruits and vegetables made at receiving points was 32,531 cars, an increase of 197 cars over the preceding year. The total number at shipping points was 165,529, an increase of 34,442 cars. In addition to the inspections made for commercial interests, 38,889,636 pounds of fruits and vegetables were inspected for the Navy Department; 2,608,363 pounds for the Marine Corps; and approximately 8,600,000 pounds for the laid-up fleet and for various steamship lines. Substantial savings are effected for the Federal Government through the inspection service.

There has been a material increase in the number of export inspections of boxed and barreled apples in New York City. Exporters are depending more and more upon the Federal certificate as an aid in closing their financial transactions at the time the fruit is delivered to the steamship companies. The greatest increase in number of shipping-point inspections made was in California, this being due largely to a great increase in the number of grape inspections, 36,069 cars having been inspected in 1925-26 compared to 18,783 in 1924-25.

An increased willingness has been shown in practically all sections to accept certificates on cars which failed to meet the grade requirements. Shippers are finding that they can sell cars which are slightly under grade at only a slight reduction if they support their state-



ments of the quality of such cars by Federal-State certificates. Reductions in price on slightly off-grade cars are usually much less if made at the shipping point than if made after the product has passed into the hands of the buyer.

### Hay Service Extended

Prior to this year the hay-inspection service has been limited by the fact that Federal standards were available only for timothy, clover, and grass hay. On July 1, 1925, standards were recommended for alfalfa and alfalfa mixed hay, prairie hay, Johnson and Johnson mixed hay, and mixed hay. On September 1, 1925, these recommended standards, together with those for timothy, clover, and grass hay were made the official standards of the United States for the inspection and certification of such hays. The publication of these additional standards caused an immediate increase in the demand for Federal hay inspection, particularly in the Western and Southern States.

Inspectors employed exclusively by the department have continued to assist other Government agencies by inspecting hay for them. The Federal specifications board adopted the Federal standards for timothy, clover, and grass hay some time ago as master specifications for all Government purchases. In November, 1925, they adopted in a similar manner the standards for alfalfa hay, prairie hay, Johnson hay, and mixed hay. In January a conference was held at the hay standardization laboratory in Washington, which was attended by representatives of nearly all Government departments interested in the purchase of hay. The standards were explained at this meeting and the various departments were offered the benefit of the inspection service. Considerable changes in methods of purchase were made in several of the departments as a result of this conference. This will result in financial saving to the Government and improvement in the quality of hay received on contracts.

### MOVEMENTS OF POPULATION

The movement of farm people away from farms and the reverse movement of city people to farms when thoroughly understood constitute an important index of the agricultural situation. A study of these movements of population during the last five or six years throws considerable light on the present trend of rural events.

Information obtained from many sources indicates that in 1920 there was a net gain in total farm population of approximately 500,000 over the preceding year, when according to the United States Census reports there were 31,614,269 persons living on farms. The prosperity of farming at that time apparently restrained the customary flow to cities of young people between the ages of 20 and 25. Moreover, the annual movement of prosperous retired farmers to town was offset by the arrival of city people drawn to farming.

The year 1921, however, was marked by striking drops in prices for farm products and saw the beginnings of an unusual movement of population to the cities. Although many persons who were tempted to leave farming stayed on farms, in the hope that soon the tide would turn and prosperity flow farmward, some were forced out

of agriculture. The result was that the net increase of farm population that year fell from 500,000 to 200,000.

In 1922 a department survey indicated that the net movement of persons to cities reached the 1,000,000 mark, which entailed a net loss in the farm population of 460,000 persons.

In 1923 the drift of population to cities continued in full force, probably reaching its height and causing a net decline in the farm population equal to or possibly somewhat exceeding that of 1922.

Another survey of the situation was made by the department in 1924. It showed that while forces tending to drive people to cities were still in operation (more than 2,000,000 persons moved to cities in 1924) other forces were sending back from cities to farms a larger number than formerly. This return movement in 1924 totaled 1,396,000 persons, and reduced the net loss to the farm population to 182,000.

### The Cityward Movement

The movement of population from farms to cities, towns, and villages in 1925 is estimated to have totaled 2,035,000 persons. The reverse movement to farms is estimated to have been around 1,135,000 persons. There was consequently a net movement away from the farms of 901,000 persons. Births on farms during 1925 were estimated at 710,000 and deaths at 288,000, leaving a natural increase of 422,000, which reduced to 479,000 the loss due to the cityward movement of population.

The large movement back to farms in 1924 and in 1925 doubtless included some persons who had sold their farms in recent years, but were obliged to take them back on account of the failure of promised payments. It doubtless also included many farm owners who found after a year or so that they could not afford to live in the city on the rentals of their farms. In the return flow of population to the farms there were likewise many laborers and former farm tenants, who had failed to find their expectations fulfilled in the cities.

In normal times there is a constant interchange of population between the country and the town. As farmers retire to cities, so city people retire to farms; laborers move back and forth from farm to city and from city to farm; and a stream of youth of both sexes goes permanently from farms to cities. All agencies seeking to promote the general welfare, whether rural or urban, should work together to reduce to a minimum the inevitable dislocations due to this interchange of people. Yet, looking at it from another point of view a reasonable movement one to the other benefits society. It is the extent of such excess movement from farm to city which is disturbing.

### PACKERS AND STOCKYARDS ADMINISTRATION

The Packers and Stockyards Administration is a separate unit of the department organized to carry out under the direction of the Secretary the purposes of the packers and stockyards act. The purposes of the act are in a general way to promote fair, impartial, open, and competitive conditions in the livestock and meat-marketing process of the country. The act provides that the rates and charges

made at the public markets shall be just, reasonable, and nondiscriminatory, and prohibits any market agency or dealer from engaging in any unfair, unjustly discriminatory, or deceptive practice at a public market. Provision is also made for the correction of any unfair, unjustly discriminatory, or deceptive practices by packers in the manufacture and distribution of packing-house products in commerce.

Seventy-eight stockyards have been posted by the Secretary as coming within the jurisdiction of the act. Approximately 5,600 market agencies and dealers and 850 packers are also subject to regulation. All market agencies and dealers operating at public stockyards are required to register and carry adequate bonds to cover their obligations. The stockyard companies and market agencies are required to file schedules of their rates and charges. If a schedule is filed that appears to be unreasonable or discriminatory, the policy of the administration is to secure an adjustment informally where possible. If this can not be accomplished, formal proceedings are held to determine the reasonableness and lawfulness of such rate or charge.

#### Many Actions Started

During the fiscal year 19 formal dockets have been initiated and action has been taken with respect to 11 other cases which were pending at the beginning of the year. Of these cases 7 involve the general schedule of stockyards rates and charges, 2 involve the general schedule of commission charges filed by all the market agencies operating at their respective markets, 13 involve trade practices, and 9 involve insolvency. During the year 5 of these cases were closed by being dismissed without prejudice, in 9 cases the registrant was suspended, and in 4 cases a "cease-and-desist" order was issued.

Special attention has been given to the bonding of the market agencies and dealers. New forms of bonds have been prepared covering the different classes of business of the registrants. A complete physical valuation has been made of all the properties of the Denver Union Stockyards Co. At a number of the yards improved scales have been installed. Attention has been given to the testing of the scale equipment, and weighing instructions have been issued and forwarded to the weighers at all markets.

By an act of Congress, approved May 5, 1926, the packers and stockyards act was amended to provide that in any State where the weighing of livestock at a stockyard is conducted by a duly authorized department or agency of the State, the Secretary may register it as a market agency for the weighing of livestock received at such stockyard. In accordance with the provisions of this amendment the Railroad and Warehouse Commission of the State of Minnesota has registered as a market agency and is furnishing the weighing service at the South St. Paul stockyards.

#### ALFALFA AND RED-CLOVER SEED TESTS

The wide differences in agricultural adaptability within the United States of alfalfa and red-clover seed produced in different foreign countries, to which reference was made in my report of the previous year, have received constantly increasing attention. It is clear that



the information regarding the country producing seed of these two crops is of unusual importance to the American planter. Trials with alfalfa, red clover, and seed from various countries are under way, in most instances in cooperation with State agricultural experiment stations, although many years' experiments will be required to determine accurately the adaptability of seed of different origin to different sections of the United States.

Determining the winter hardiness of alfalfa varieties or strains imported from different countries is necessarily slow. Up to the present time the results available have shown that alfalfa seed from Turkestan is of little value for the greater part of the United States, particularly in those humid sections where alfalfa is an important crop. Seed from South Africa produces plants that are not sufficiently hardy for the Northern States, and, in the majority of tests, plants grown from seed from Argentina have suffered seriously in the United States over the first and second winter.

In considering the adaptability of red clover to different regions of the United States, three general regions may be distinguished: First, the region in which severe winters prevail, with low temperatures and with little snow or with great fluctuations in temperature; second, the region in which anthracnose or similar clover diseases are not important factors and in which the winters are somewhat milder; and third, regions in which the winters are not severe and in which anthracnose or other clover diseases are of major importance. Clover from domestic seed, including that grown in Canada, is more resistant to severe winters than any foreign clover so far tested, and in regions of severe winters only American-grown clover seed should be used. Seed of disease-resistant types of domestic clover should be used, if possible, where anthracnose or similar diseases prevail.

#### Seed Act Amended

The widespread interest in these results on the part of farmers, seedsmen, and others more or less directly concerned resulted in an amendment, April 26, 1926, to the Federal seed act (formerly designated the seed importation act), which requires that all seed of alfalfa and red clover imported into the United States be colored, so that the purchaser may know whether he is buying seed of domestic or foreign production.

The general scope of this amendment and the regulations promulgated for its enforcement may be briefly summarized as follows: Whenever the Secretary of Agriculture, after a public hearing, determines that seed of alfalfa or red clover from any foreign country or region is not adapted for general agricultural use in the United States, entry of such seed is prohibited unless at least 10 per cent of the seed be stained a red color. This 10 per cent red coloring is required for Italian red clover seed effective September 2, 1926, and for alfalfa seed produced in Turkestan and Africa effective September 25, 1926. Moreover, all alfalfa and red clover seed for which the country of production can not be shown is prohibited entry unless at least 10 per cent of the seed be stained red. Except as provided in the foregoing, entry of alfalfa or red-clover

seed into the United States is prohibited unless approximately 1 per cent of the seed is colored violet, if produced in Canada, or green if produced in any other country. The amendment also provides that any seed in interstate commerce that is willfully misbranded may be confiscated by the Secretary of Agriculture by a process of libel.

### SOY BEANS

No single agency has done more to develop the soy-bean industry in the United States than has the Department of Agriculture. Introduced from the Orient many decades ago, the soy bean only recently attained a recognized place in the cropping system of American farmers. As late as 1917 less than 500,000 acres were devoted to the growing of soy beans for all purposes. In 1924 there was a total of 2,500,000 acres, of which about 1,000,000 acres were used for hay, 1,000,000 acres for pasture and ensilage, and 500,000 acres for seed. This increase in the acreage devoted to soy beans in the United States is largely due to the development of better-adapted varieties. Previous to 1898, there were not more than eight varieties of soy beans generally grown in the United States, and of these only two, the Ito San and Mammoth Yellow, are now grown to any extent. In 1924, the last year for which data are available, the total value of the seed of all varieties of soy beans grown in the United States was estimated at \$23,917,500. Of this total \$12,675,540 must be credited to new varieties introduced by the department. The total value of the soy-bean hay crop in 1924 was \$18,360,000, and of this value the new varieties were responsible for a little more than half.

There is no way of estimating the value of the soy beans used for pasture, ensilage, and soil improvement, but it is probable that at least 25 per cent should be added to the above figures as the value represented by these uses of the crop. In estimating the contribution made by the new varieties, not all the States growing soy beans are represented. Data were obtainable only from the principal soy-bean States.

#### Older Varieties Supplanted

The extent to which new varieties have supplanted the older ones in certain States is apparent when the following facts concerning soy-bean hay and seed only are considered. The Biloxi makes up 43 per cent of the total production in Louisiana; Black Eyebrow, 25 per cent in West Virginia; Haberlandt, 32 per cent in Kentucky; Laredo, 25 per cent in Mississippi; Manchu, 45 per cent in Iowa; Midwest, 50 per cent in Indiana; Mandarin, 42 per cent in South Dakota; Morse, 28 per cent in Missouri; Virginia, 55 per cent in Virginia; Wisconsin Black, 40 per cent in Wisconsin; and the Wilson, 53 per cent in Pennsylvania and 52 per cent in Maryland. The results obtained from the search for new varieties appears to have justified the work and compensated for the expense many times over. Of the total production of soy-bean hay and seed, 53.7 per cent is represented by varieties introduced and developed by the department.

### SUDAN GRASS

This valuable grass sorghum and annual hay plant was obtained in 1909 from northern Africa, through the efforts of C. V. Piper, then agrostologist in charge of the office of forage crops of the department. It was immediately successful, particularly in the southern Great Plains, and in 1918, nine years after its introduction into the United States, the value of the annual crop of Sudan grass was conservatively estimated at \$10,000,000. Like the sorghums, it has proved able to survive periods of drought, and its fondness for hot weather during its growing period has resulted in its extensive use as a summer pasture, not only in the Great Plains but also in the Corn Belt. The acreage has practically doubled since 1918, and is becoming more or less unvarying around 1,000,000 acres sown annually. It is appreciated as an emergency hay crop and summer pasture grass in Iowa almost as much as in Texas, and the interest in it is increasing as far east as Ohio. Although the value of a pasture crop is exceedingly difficult to appraise, there is justification for the belief that the annual crop of Sudan grass in recent years is easily worth \$16,000,000. It has supplanted millet to a considerable extent as a catch-crop, on account of its sordinarily higher yields and the greater palatability of the Sudan grass hay. Seed of it is now abundant and fairly cheap, and this grass promises to continue as one of our regular forage producers, returning each year in this one item many times the entire annual expense of forage investigations in the the department.

The introduction of Ladino clover was accomplished in Idaho about 1915, and since then about 40,000 pounds of Ladino clover seed have been produced and there have been established about 1,000 acres of the very best kind of dairy pasture. The total value of this new industry, although comparatively small, may be said to have added some \$13,000 to \$15,000 a year to the income of Idaho farmers.

### ABACA IN TROPICAL AMERICA

The so-called "hard" fibers furnish the entire supply of raw material used by American manufacturers for making binder twine, and the greater part of the raw material used for all other kinds of cordage except that made from jute and cotton. In addition to large quantities of miscellaneous hard fiber cordage between two and three hundred million pounds of binder twine are consumed annually on the farms of this country. The American farmer is, therefore, our largest consumer of hard fibers.

The four fibers that furnish practically all of our supply of this raw material are henequent, sisal, abaca, and istle. The imports of these four fibers in 1925 amounted to 215,758 tons valued at \$43,434,169. The henequent is obtained principally from Yucatan, the sisal from Netherlands India, the Colonies of East Africa, and the Bahama Islands, the abaca from the Philippine Islands, and the istle from the northern part of Mexico. None of the hard fibers are produced in commercial quantities within the continental United States.

Special attention has been given during the last year to the establishment of abaca production on a commercial scale in tropical



America. The entire world supply of abaca fiber, with the exception of a few hundred bales, is produced in the Philippine Islands. With a decreasing supply of labor, and increasing competition from coconuts and other crops, the Philippine production of abaca is barely holding its own and is not keeping pace with the world demand for this fiber. Two diseases of abaca, that have appeared in recent years, threaten to reduce still further the production of abaca. In view of these conditions, it is apparent that effort should be made to encourage the growing of abaca in tropical regions other than the Philippine Islands.

### Difficult Shipping Problem

Abaca, when propagated from seed, does not come true to type, which necessitates propagation either from rhizomes or suckers. The shipment of plant material of this character from the Philippine Islands to the American Tropics has proved to be a difficult problem, and shipments of abaca plants made in 1923 and again in 1924 failed to survive the long journey. During the calendar year 1925, with the cooperation of the War Department, the Navy Department, and the United States Shipping Board, arrangements were made for the routing of a freight steamer direct from the abaca-producing province of Davao, in southern Mindanao, to the Canal Zone. Provision was also made for the storage and handling of growing plant material on this ship.

During the months of July and August, 1925, 1,438 selected abaca plants, representing six different varieties, were accordingly collected on five different plantations in Davao. This material, which included rhizomes, suckers, buds, and growing plants, was packed in a number of different ways, and was shipped from Davao August 21. The shipment was en route 44 days. On arrival the Canal Zone plants were reshipped to the northern part of the Republic of Panama, where arrangements had been made for planting them in an isolated plant quarantine section. About 50 plants were subsequently taken to the plant introduction gardens at Summit, in the Canal Zone.

Of the total shipment of 1,438 plants, 1,052 plants, or 73.2 per cent were alive when the shipment arrived at its destination. There was a relatively heavy loss after the plants were planted in the plant quarantine station. At the close of the year about 500 plants were growing and in good condition.

### DEMAND FOR RUBBER INFORMATION

Rubber has become an essential to agricultural production and marketing of crops, as well as to urban industries. About three times as much rubber is used in the United States as in the rest of the world. The present development of our civilization could hardly be maintained without rubber. The precariousness of being so completely dependent upon the East Indies for an indispensable product is being recognized.

Interest in the possibilities of rubber production is intensified by the large areas of unused or partially used land in the United States, especially in the southern and southwestern regions, where it is hoped

that rubber production may prove feasible. If suitable plants were discovered, and methods of utilization devised, the well-known disparities in the cost of labor between the oriental regions and the United States might be overcome, as we now grow cotton, rice, sugar, and tobacco in competition with the oriental countries.

Large areas of land now of little value in tropical America may be utilized for the production of Hevea rubber if suitable methods can be devised. Experiments to determine such possibilities are being made in numerous localities in the Canal Zone and in neighboring districts of the Republic of Panama, as well as in Haiti and southern Florida. On account of different conditions in tropical America, the methods that are used on the large rubber plantations of the East Indies have not appeared practicable, but other methods may be developed which will make production possible without contract labor and also avoid the large initial outlay and overhead charges of the East Indian plantation system. Careful experiments are needed to show the range of conditions under which it is possible for the trees to grow and to produce rubber, and to demonstrate a practical method for bringing the trees through the early stages of the development with the smallest requirement of labor and expense. The first result of these experiments is to show that the range of adaptation of Hevea, the Para rubber tree, is much wider than has been supposed.

#### Hevea in Tropical America

Experiments with Hevea and other rubber-producing plants are going forward in Haiti, in the Canal Zone, and in the Republic of Panama. Seeds and young plants of Hevea from Haiti were taken to Panama, and are being tested in numerous localities. The tapping of mature Hevea trees in Haiti has been carried into the second year with yields distinctly larger than at the corresponding periods in the first season. Compared with records of individual trees in Ceylon and elsewhere in the East Indies, the range of variation is much the same, and also the average production per tree. Thus there is no question of the feasibility of commercial production of rubber in Haiti, if a suitable system can be established. A small shipment of the crude rubber was sold in New York at the full market price of East Indian rubber.

Seedlings of Hevea are tolerant of shade and specially adapted to forest undergrowth conditions, so that planting in the open is not necessary. Slower growth of the plants in the early stages does not interfere with a vigorous and normal development of the trees after they have become well established. The use of cover crops like the pigeon pea, or Congo bean, may be desirable for controlling weeds or grass, shading the soil, and gradually establishing the desirable condition of the forest leaf-litter covering; also the closer planting of the rubber trees may serve the same purpose. While the tapping size might be reached somewhat later in close-spaced plantings, the cost of establishing plantations might be less and the outlook for sustained production might be improved, since the bark surface would be greater. Also the removal of low-yielding trees could be accomplished with less difficulty or need of replacement.

### Promising Rubber Plants

Several of the tropical rubber-producing species thrive in southern Florida and appear to be so well adapted to local conditions that extensive cultivation might be possible if satisfactory methods for extraction of the rubber could be devised. The Assam rubber tree (*Ficus elastica*) and the purple-flowered rubber shrub (*Cryptostegia grandiflora*) are widely distributed and grow very well in many localities in the southern half of Florida. *Cryptostegia madagascariensis* has also been introduced into Florida; this species has been studied in Mexico and Haiti and is known to produce rubber of fair quality. The collection of rubber plants now growing at the plant-introduction garden Chapman Field, near Miami, includes numerous species of *Alstonia*, *Asclepias*, *Carissa*, *Carpodinus*, *Castilla*, *Cerbera*, *Cryptostegia*, *Euphorbia*, *Ficus*, *Funtumia*, *Hevea*, *Jatropha*, *Landolphia*, *Manihot*, *Mascarenhasia*, *Parthenium*, *Pedilanthus*, *Plumeria*, *Rhobdadenia*, and *Urceola*.

Rubber plants that are natives of dry regions are being tested in California, in the coast districts as well as in the interior valleys. Several dry-country rubber plants are known in Mexico, while others are reported in South America, Africa, and Madagascar. Special attention is being given to one of the native species of milkweed (*Asclepias subulata*), which appears to be the most promising for waste lands and for producing the largest quantity of rubber-bearing material readily and cheaply.

### FOREIGN PLANT INTRODUCTION

Methods for safeguarding the country against foreign crop pests in connection with plant-introduction work are being steadily improved. All plant material from foreign sources is brought to Washington, D. C., and subjected to rigid inspection and to treatments if required. Much of the material goes into quarantine and some is detained under special safeguards. Material that is released to go to one or more of the plant-introduction gardens is under surveillance all the time it is being grown and propagated. Just before distribution a final inspection is given. These protective measures are developed cooperatively by the Bureau of Plant Industry and the Federal Horticultural Board.

Several years ago one of the agricultural explorers of the department discovered a remarkable cherry growing in the Ecuadorian Andes. This fruit is closely related to our wild black cherry. It occurs all the way from Mexico southward. For a long time only seed could be obtained, but two years ago some budwood was introduced and successfully established under glass at the Bell (Md.) plant-introduction garden. Four small trees from this budwood came into bearing this year. The fruit is of good size and very fair quality. The Capulin cherry, as this fruit is called, is believed to be adapted to our Southern States; at least it will be given extended trial there. It is essentially a warm-country cherry. A cherry for the home gardens of the South and for local markets would be a valuable acquisition. The fruit of the Capulin as grown here is about three-fourths to 1 inch in diameter and of a pinkish-red color. It is borne in racemes, like our native black cherry.



Bamboos are attracting much interest in this country, especially since the recent publication of a small bulletin on their growth and uses in the United States. The timber bamboo is one of the most striking forms. About 8,000 plants of this species were distributed in the spring of 1926. Cooperators are being encouraged to put out and care for small groves of from a quarter acre to an acre. It is important to make certain of a future supply of plants. The plants must be propagated by division, as seed is not available. Besides the timber bamboo, which finds many uses on the farm and in commerce, numerous other species are being tested and propagated—mainly at the plant introduction garden of the Bureau of Plant Industry, near Savannah, Ga.

### TUNG-OIL TREE INTRODUCTION

Commercial plantings of the tung-oil tree, a recent introduction of the department from China, have now reached a total of about 1,500 acres. The new industry is centering in north-central Florida, and is being fostered by interests connected with the paint and varnish industries, in which tung oil is an important factor. Most of the bearing trees are young, and consequently the seed crop small. All available seed is still being used for planting purposes. While there is at present an ample supply of tung oil from China for the needs of American manufacturers all that is received is more or less adulterated or otherwise inferior in quality and there is a need for a commercial supply of the pure oil. The imports during the calendar year 1925 amounted to 101,550, pounds, with a declared value of \$11,385,000.

Interest in the Chinese elm (*Ulmus pumila*) has increased each season since its first introduction, and very favorable reports have been received from all sections of the country. Because of its rapid growth and its resistance to drought and alkali special interest has attached to its usefulness in the Great Plains region, where there is great need for a shade tree also suitable for use in windbreaks. No other tree has met so successfully the requirements of this region. The ever-increasing demand for it has resulted in its being offered by a number of nurserymen in that section, and there is little doubt but that hundreds of thousands of these trees will be planted as rapidly as they become available.

### RIPENING OF DATES

From the elaborate pollination experiments on dates it has been determined that the type of pollen used will make possible either the very early ripening or mid-season ripening or late-season ripening of the particular variety of dates that are pollinated. Not only the time of ripening but the size and flavor of the mature date are determined to a very large extent by the kind of pollen that is used.

The extent to which this may apply to fruit crops other than the date is now under consideration. It is possible that the same principle may be applied to secure more or less control of the quality of other fruits. In so far as the production of dates is concerned, this discovery is of unusual importance because of the material extent of the control of fruiting habits of the different varieties of dates now being grown in the Southwest.

## SUGAR BEETS

Distinct advances have been made in the investigations into the curly-top of sugar beets, which is perhaps the most serious disease with which beet growers have to contend in the western areas. A mild form of the disease first observed at Bakersfield, Calif., in 1924, was studied and found to be caused by virus that had previously passed through certain wild hosts, subject to the disease, before being transmitted to beets by the insect *Eutettix tenella*. This remarkable discovery of attenuation of the virus is believed to be the first instance ever recorded of such a phenomenon in a disease of plants.

Additional data on the control of the sugar-beet nematode by rotation of crops was obtained at Salt Lake City, Utah, and this method is now unhesitatingly recommended as the only practicable one under present conditions in Utah, Idaho, Colorado, Wyoming, Montana, and California.

An investigation of the best conditions for storage of commercial beets was brought to a conclusion at Salt Lake City. It had been previously brought out that enormous losses of sugar occur in the piles at beet dumps and in factory bins on account of the physiological activities of the beets which go on, although at a diminished rate. The principal recommendation resulting from this investigation is to shade the surface of piles with a moisture-holding inexpensive covering; which should be sprayed with water during dry weather. It was proved that this lowers the temperature and cuts down ventilation, which reduces respiration and the resulting loss of sugar.

## WHITE PINE BLISTER RUST

Blister rust was found in the Northwest in the fall of 1921, when it was discovered at Vancouver, British Columbia, and shortly afterwards at Mount Vernon, Wash. Subsequent investigations indicate that it was introduced from France in 1910 on a shipment of young white pines that were planted near Vancouver. Field conditions favored its rapid spread and it became thoroughly established on western white pine in the coastal region of British Columbia. Following the discovery of the disease in the West, the department in 1922 and 1923 undertook a cooperative survey to determine the limits of infection and the possibilities of natural or artificial barriers delaying the advance of the disease into uninfested regions.

The season of 1923 was notable principally for the spread of infection southward through the dry belt of central British Columbia and through the Lake region of eastern British Columbia. Infection on cultivated black currants was found to be generally scattered over the dry belt and extended as far south as the central part of Okanogan County, Wash. Infection in eastern British Columbia was found to have extended southward to Grand Forks, British Columbia; Danville, Ferry County, Wash.; and to Nelson, British Columbia. It was also found that numerous *Ribes* were each year infected in the Puget Sound region of western Washington. Their proximity to native white pines made it probable that these pines were becoming infected.



### Idaho Pine Threatened

In general, at the end of the 1923 field season, the Idaho white pine belt was directly threatened with invasion from the Northwest, through the dry belt and from the north through Nelson, British Columbia, and near-by points. Also, the increase of infection in western Washington constituted an ever-increasing menace of infection in western Oregon.

In 1924, the department in cooperation with the affected States and local agencies began a control program projected over a period of 10 years which aimed at delaying the spread of the disease and at developing and applying practical control measures. During the two years the program has been under way, good progress has been made in carrying out such measures as were considered worth while and in developing suitable control practices.

During 1925 two important developments in the spread of the rust were noted. First, western white pines were found to be infected at Nelson, British Columbia. This pine infection resulted from Ribes infection found at that point in 1923 and is significant in that it constitutes a focus from which Ribes infecting spores can be disseminated over long distances, thus greatly increasing the risk of initial infection of Ribes in northern Idaho. Second, the disease was found in the coast region of northwestern Oregon at Pacific City, Wheeler, and Knappa. This spread undoubtedly denotes the presence of infected pines in the Puget Sound region of Washington some distance south of the Canadian border. It constitutes a direct thrust of the disease toward the sugar-pine regions of southwestern Oregon and California.

### Blister-Rust Control in the East

Steady progress in blister-rust control in the East has been made since the beginning of the control program in 1922. The developmental work prior to 1921 resulted in 1,036,903 acres of land being cleared of 14,491,503 Ribes, of which 91,718 were cultivated bushes. At the same time, the average per acre cost of eradication was reduced from 72 to 18 cents. From the beginning of the control program in 1922, a total of 29,988,089 Ribes, of which 204,451 were cultivated bushes, have been eradicated from 3,217,140 acres of land at an average cost of 18 cents per acre. Since 1918 a total of 44,479,592 Ribes of which 296,169 were cultivated bushes, have been destroyed on 4,254,043 acres of land.

The majority of owners of cultivated Ribes destroyed their bushes without compensation. During 1925, 59,458 cultivated bushes were uprooted, yet the State had to pay for only 2.2 per cent or 1,300 plants. A total of \$514.55 was paid in compensation for cultivated Ribes to 49 owners. During the four years the program has been under way the cooperating States, towns, and individuals have made available a total of \$723,451.02 for cooperative control work.

The blister-rust situation in the Middle Atlantic and Lake States differs materially from that in New England and New York. The southward advance of the disease into northern New Jersey and northeastern Pennsylvania has been comparatively slow. The difference in the behavior of the disease in this region is probably due to the



influence of host associations, and perhaps other factors not definitely known at present. Wild Ribes are moderately abundant, but the pine host is so scattered that field conditions are unfavorable for the rapid spread of the disease. Cooperative scouting in New Jersey during 1925 resulted in the finding of infected cultivated black currants in Monmouth, Passaic, Warren, and Sussex Counties. Similar scouting in Pennsylvania showed the rust present in Wayne County at Callicoon, Rileyville, and Damascus, where it had occurred in former years, and at Laurella, a new location. In two instances the disease was on cultivated black currants, in the third on pines and black currants, and in the fourth on pines and wild gooseberries. The southward spread of the rust is being carefully watched, and steps will be taken, in cooperation with the States concerned, to secure the application of control measures to valuable pine stands as the need arises.

### BARBERRY ERADICATION

The campaign for the eradication of the common barberry for the purpose of reducing stem-rust losses of small grains has been in progress eight years. This year's results show that a great many barberry bushes still exist in the barberry-eradication area. Some of these bushes are in areas not yet reached in survey and eradication, for barberries are numerous in the old established farming communities of the counties not yet covered in the first survey. Others are bushes overlooked in surveys, and these cause the greatest concern. The second-survey results show that a comparatively large number of plantings were missed on the first survey. These are scattered well over the entire area.

In spite of the extreme care used in the second survey, a check survey in a county picked for the purpose showed that a comparatively large number of barberries may be missed even on second survey unless every foot of the area is inspected. All areas of escaped bushes must be completely inspected, and care must be exercised to insure that the extreme limits of these areas are reached. Numerous seedlings may continue to develop each season in the vicinity of locations from which fruiting bushes were removed. The missed bushes and the continuously developing seedlings are hidden centers of stem-rust infection. Patience in searching for bushes and seedlings, the following up of all reports of the early and heavy development of stem rust in local areas, and the eradication of bushes found will aid materially in the control of stem rust.

In the eastern winter-wheat producing States of the eradication area, stem rust of wheat is controlled as soon as the barberries are eradicated from an area. It may be that stem rust developing early in southern climates under certain conditions is spread widely by winds to the spring-wheat producing States. However, in 1925 142,550 barberry bushes and 701,796 seedlings were found in the counties surveyed. In the second survey in Minnesota, 1,124 bushes were found on 134 properties in 10 counties. In North Dakota, 110 bushes were found on 15 properties in 5 counties. In South Dakota, 446 bushes were located on 66 properties in 10 counties, and in Iowa, 1,125 bushes on 145 properties in 8 counties. Similar results were obtained from the second survey in the other States. Granted that

much rust may develop from untraced sources, it is nevertheless true that wherever very severe local stem-rust epidemics have continued to recur year after year, a careful survey usually reveals one or more plantings of barberries. Records of hundreds of these epidemics are filed in the offices of State officials, and many cases of the reduction of rust by eradication of local barberries are testified to each year by farmers and field men.

#### Many Bushes Still Exist

Thousands of bushes and seedlings, no doubt, still exist in the 13 States of the eradication area. A preliminary survey of a few townships in border counties in Kansas and Missouri in 1924, and a further check for stem rust in the spring of 1925, show that many plantings of barberries exist there. Some of these when examined were spreading stem rust to grains and grasses, others apparently were not.

There are eradication laws or regulations under which barberry bushes may be eradicated not only in the 13 States of the eradication area, but also in Missouri, Oregon, Washington, West Virginia, and Tennessee. Interest in the eradication of barberries is manifested locally in Pennsylvania. In the part of Virginia where *Berberis canadensis*, a native barberry, spreads stem rust to local grain crops local eradication of this native barberry is in progress. North Carolina scientists are showing interest in the spread of stem rust from *B. canadensis* in that State.

#### SOIL SURVEYS

The hitherto unknown characteristics of many soils in the United States have been determined by the Bureau of Soils in the last fiscal year. Survey projects were either begun or completed in 29 States, covering a total of 28,508 square miles, an area equal to more than half of Iowa. This means that during the last fiscal year definite knowledge has been gained of an additional 18,245,120 acres of soils—the Nation's most important agricultural resource—regarding their present and potential productiveness, the type of agriculture for which they are best suited, methods of soil improvement, crop adaptation, and their proper management.

An intensive field study was made of the important soil types of north-central Indiana, with a view to determining the relation between the distinguishing soil characteristics and soil productiveness and management. This marks the beginning of an entirely new and important line of soil investigation. Soil mapping and classification are now pursued in harmony with the dynamic or genetic conception of soils—a conception which recognizes the development of distinguishing soil characteristics under the influence of climatic and biotic forces, and not according to the old idea of classification on the basis of the physiographic position of soils. The facts collected in the study of the Indiana soils show that when soils are classified according to these natural, distinguishing characteristics they correspond to the soils to which the farmers have given distinction in local descriptive names, in their estimates of average yields per acre, in their soil-management practices, and in their estimates of relative land values.



### Alkali Soils in Illinois

Soil studies, in cooperation with the University of Illinois, have brought to light a wide distribution of certain "alkali" soils in southern Illinois, hitherto not known to occur east of the Great Plains. These soils, from the surface downward, are similar to the so-called "Szik" soils of Hungary, the "Solonetz" soils of Russia, and to the "slick spots" which occur in regions of low rainfall in the United States. These peculiar soils, in their development, owe their distinguishing characteristics to the presence of certain salts which are common in the dry regions of the West, but which were not known to exist so far east as southern Illinois. Such a distribution of alkali soils affects to a marked degree the type of crops that can be grown in the affected area.

### EXCLUSION OF PLANT PESTS

The protection of American agriculture from new insect pests and plant diseases is one of the more important activities of the department. It is known that our chief insect and disease hazards are of foreign origin, and that the importation of plants and plant products without inspection or safeguards of any kind has been the means of entry of practically all of these imported pests. Since 1912, under the enforcement of the plant quarantine act, the rapid stream of entry of such pests has been largely stopped. This desirable result is being obtained by the enforcement of some 22 foreign quarantines restricting, controlling, and safeguarding by inspection the entry of the plants and plant products known to be carriers of specific plant enemies. For the enforcement of these orders, the department is maintaining an inspection service at the principal ports of entry in the United States, the utility of which is daily attested by the interception of new and important pests.

Under the authority given in the plant quarantine act to control and prevent the spread of new plant enemies that have gained more or less local foothold in the United States, some 17 of these are now under domestic quarantines, among which may be mentioned the pink bollworm of cotton, the Japanese beetle, the European corn borer, the gipsy moth, and the white pine blister rust. These domestic quarantines also include those necessary to prevent the spread of pests to the continental United States from the Territories of Hawaii and Porto Rico. The most important of these quarantines is that intended to prevent the entrance of the Mediterranean fruit and melon fly into the mainland of the United States.

### Control of Pink Bollworm

It may be here noted that the pink bollworm has not reappeared in the important cotton regions of central and eastern Texas and in Louisiana, where it was formerly widely established, indicating the continued success of the eradication and control measures. The effort to confine the gipsy moth to its known distribution, covering now much of the New England States, has been accomplished by the maintenance, for the last two years, of a defense belt extending along the Champlain-Hudson River section. It is generally recog-



nized that the spread of the gipsy moth into the mountainous regions of central and northern New York would make it very difficult, if not impossible, to prevent the rapid spread of this serious forest and orchard pest throughout the United States.

In the case of the Japanese beetle and the European corn borer, natural and local spread can not be prevented, but control measures enforced with respect to these pests have effectively prevented their long-distance spread. The Japanese beetle has spread during the year into two new States, namely, New York—in the immediate vicinity of New York City, in the Hudson Valley and on Long Island—and the southwestern corner of Connecticut. The white-pine blister rust has appeared in Oregon, evidently spreading from its known western locations in British Columbia and Washington. New quarantine control measures for this disease have been adopted and are now being enforced. It is hoped that these will give greater protection against further spread to important white-pine areas in the Western United States not yet invaded.

#### **Eradication Sometimes Impossible**

It is recognized that such pests and diseases are introduced and firmly established over considerable areas, their eradication is impossible and their spread, probably ultimately throughout their possible range in the United States, can not be prevented. The control efforts which the department is carrying on are intended to retard the spread of these pests and to reduce losses pending effective local control.

Authority granted in the appropriation act for the fiscal year 1927, to inspect domestic fruits and vegetables and other plants and plant products offered for export to meet the sanitary requirements of foreign countries, became effective July 1, 1926. Such inspection is now being given. This is a new service but is expected to be self-supporting under authority granted to make reasonable charges for inspection.

The decision of the Supreme Court of March 1, 1926, in the case of the Oregon-Washington Railroad & Navigation Co. versus the State of Washington, in effect, ruled that, with the Federal plant quarantine act in force, "State action is illegal and unwarranted," and invalidated upward of 200 State quarantines. This situation necessitated an amendment of the plant quarantine act to make it possible for any State to take necessary protective action with respect to any subject which has not been specifically taken up under Federal quarantines.

A joint resolution was therefore drafted, amending section 8 of the act to give such powers to the several States. This amendment received the sanction of Congress and was approved by the President April 13, 1926. The amendment also authorizes the Secretary of Agriculture to cooperate with any State, Territory, or district in the enforcement of any such quarantines and, further, gives authority for any State to exercise its police powers with respect to any articles shipped in violation of a Federal plant quarantine. The amendment of the act providing for Federal and State cooperation in quarantine activities should greatly harmonize and strengthen such activities in the future.

## ANIMAL INDUSTRY

The year just completed has been one of excellent progress in bettering conditions for the production of domestic animals. Methods for the eradication and control of animal diseases have been highly fruitful of results. Efforts to improve the quality of livestock by better breeding have shown gains both in public interest and in actual betterment of stock. In regulatory work also there has been a growing spirit of cooperation from individuals, transportation companies, the meat trade, and livestock organizations. This work has to do largely with supervising the importation and interstate movement of animals, inspection of meat, and supervising the manufacture of biological products.

It is gratifying to report that the United States again is free from the dangerous foreign malady, foot-and-mouth disease, which gained entrance in 1924 and recurred in 1925. Fortunately the ravages of the disease were confined in both outbreaks to limited areas in two States—California and Texas. Following a period of very close supervision over the regions affected—and especially of the rough, mountain ranges in California where deer had become infected—the department withdrew its last quarantine restrictions June 10, 1926.

The appearance of foot-and-mouth disease in Mexico near the end of the fiscal year was occasion for renewed precautions and vigilance. The department is optimistic, however, regarding the ability of the United States to maintain its freedom from the plague and to eradicate any infection which may ever gain entrance. Public sentiment supports the aggressive measures used in combating the malady by quarantine, slaughter, and burial or burning of infected carcasses. Success in eradicating the outbreaks of 1924 and 1925, and of establishing complete freedom from the disease in 1926, has been due largely to excellent cooperation among livestock owners and county, State, and Federal officials.

## BOVINE TUBERCULOSIS DECLINING

In the nation-wide effort to eradicate tuberculosis from livestock, results have been unusually gratifying. During the fiscal year 109 counties completed a series of tuberculin tests showing that infection had been present to the extent of not over one-half of 1 per cent. With the disposal of reactors and establishment of other safeguards the counties were recognized as virtually free from bovine tuberculosis. This number is greater than the total of all previous years and brings the total list of such counties to 198. The acceleration of progress in establishing county-wide areas free from tuberculous cattle supports the belief of department livestock officials that the task of eradicating bovine tuberculosis from the United States is feasible, though still of great magnitude and likely to require many more years.

During the progress of the present systematic campaign, which began late in 1917, the extent of bovine tuberculosis in the United States has declined from about 4 per cent to 2.8 per cent. These figures are estimates based on more than 25,000,000 cattle tested. A reduction in per cent means a large corresponding reduction—

when applied to all cattle in the country—of economic losses and of menace to the livestock industry. More than that, the decline of the disease in cattle means that the menace to the human race, and especially to small children, is gradually being removed. The experience of inspectors engaged in field work has revealed scores of cases in which there was an intimate relation between tuberculosis among livestock and of people on the same farm, or who used raw milk from tuberculous cattle. Public sentiment is strongly behind the campaign to eradicate tuberculosis while the degree of infection is still low—which fortunately is the condition in most localities. Prompt and aggressive measures will save many human lives, reduce losses of animals, and put the stock-raising industry on a safer, sounder basis.

Liberal appropriations for the work made this excellent progress possible. The testing is done only by trained and qualified men and under a system which insures economy of operation. The number of cattle tested during the year was 24 per cent greater than during the previous fiscal year, yet the demand for the work exceeded facilities for testing, and 4,000,000 cattle were on the waiting list for testing when the year closed. As further indication of public interest, a survey made during the year showed that over 1,200 cities and towns in the United States now have municipal ordinances requiring the tuberculin testing of cattle furnishing milk for consumption. The ordinances, the survey showed also, were being fairly well enforced except in about 1 per cent of the cases.

Meat-inspection records for the year show a gratifying decline in tuberculous infection among hogs. Of the domestic animals besides cattle and hogs, poultry also are susceptible to tuberculosis. A survey showed that fowl tuberculosis is serious in several areas, especially around the Great Lakes and westward. Suitable field measures, combined with distribution of explicit directions for reducing losses, are the means being taken to improve the situation.

### HOG-CHOLERA LOSSES

With the present widespread knowledge concerning the preventive-serum treatment for hog cholera the swine industry can be protected from heavy or sudden losses caused by that disease. As in the previous fiscal year the toll of hog cholera during the fiscal year ended June 30, 1926, was unusually low. In fact, there has been no period of exceptional prevalence since 1913-14, which was before the discovery of the cause of hog cholera and the development of means to immunize hogs against it.

The experience of nearly two decades indicates that modern methods of prevention and improved farm sanitation can stop the periodic waves of hog cholera, which before 1914 caused sudden and staggering losses and were disheartening to swine growers throughout the country.

During the fall of 1926 a situation arose which demonstrated clearly the importance of keeping swine immunized against this highly contagious disease. Owing to the slight extent of cholera in recent years, a very large proportion of swine owners discontinued the practice of immunizing their herds. As a further result the commercial production of serum declined in proportion.



Both of these conditions—large numbers of susceptible animals and shortage of serum—were responsible for extensive outbreaks in several hog-growing States until serum production again met the requirements of the industry.

### ERADICATING CATTLE TICKS

The work of eradicating cattle ticks from the areas in the South where ticks are still present continues to gain ground. Cooperative tick-eradication activities during the year resulted in the releasing of 18 counties and 9 parts of counties from Federal quarantine on account of tick fever. The areas released were: In Alabama, two counties and one part of county; in Arkansas, two counties and two parts of counties; in Florida, six counties and four parts of counties; in North Carolina, seven counties; and in Oklahoma, one county and two parts of counties. In the area previously released, 72 counties in which some tick infestation still existed were rendered entirely tick free. At the close of the fiscal year 723 of the 984 counties originally in the quarantined area were released. Of this number 601 counties were reported as entirely tick free.

During the fiscal year 1926 Texas, or tick, fever was, by act of Congress, placed in the list of contagious, infectious, or communicable diseases of livestock. The act of Congress creating the Bureau of Animal Industry in 1884 provided by a special provision "that the so-called splenic or Texas fever shall not be considered a contagious, infectious, or communicable disease within the meaning \* \* \* of this act."

To understand the apparent inconsistency of this special exemption it should be remembered that in 1884 little was known of this cattle malady, which became known as Texas fever because it often followed the introduction in northern pastures of cattle from Texas. It should be remembered also that the 1884 law antedated by about five years the bureau's discovery that the cattle tick was the carrier of this disease.

Following this discovery and particularly since systematic efforts at tick eradication have been undertaken, the repeal of this provision has been frequently recommended. But it was not favorably acted upon until the present year, when an act approved June 28, 1926, repealed the provision in section 6 of the 1884 law permitting the movement of tick-infested cattle for slaughter. The present law provides "that until May 1, 1928, cattle infested with or exposed to cattle-fever ticks may be shipped in interstate commerce for immediate slaughter after one dipping in accordance with such regulations as the Secretary of Agriculture may prescribe." After May 1, 1928, only tick-free cattle will be permitted in interstate commerce.

### SWINE SANITATION

Besides the diseases mentioned, which are of major importance, there has been progress also in reducing the toll of certain others both by regulatory and educational methods. The system of swine sanitation, developed by the Bureau of Animal Industry a few years ago in Illinois, is now being widely and effectively used throughout the Central West. It has not only greatly reduced losses of pigs.

from roundworms and associated ailments but has improved the vigor and growth of pigs raised according to the system.

Extensive experiments for the control of stomach worms of sheep completed during the year at Vienna, Va., point to the ineffectiveness of pasture rotation alone for preventing losses from this pest. Though of some benefit, the mere changing of pastures as frequently practiced is much less effective than dosing the sheep periodically with a dilute solution of copper sulphate.

During the year the department began extensive investigations of animal parasites at two field stations in the South—McNeill, Miss., and Moultrie, Ga.—there being special need for a better understanding of Southern parasite problems.

### QUALITY IN LIVESTOCK

The importance of high quality in domestic livestock has been continually urged by the department. Well-bred animals are the basis of a profitable livestock industry and an ample supply of good-quality meat and products. A definite method used for the last six years for increasing the use of purebred sires now has approximately 17,000 followers enrolled to use purebred sires exclusively in their livestock-breeding operations.

During the year Union County, Ky., after five years of persistent effort, has succeeded in banishing all scrub and grade bulls and establishing itself as the first county in the United States to use purebred bulls exclusively, there being 145 within its boundaries at the close of the year. The stallions, jacks, and boars of the county were purebred also so far as known, but effort has been centered on the improvement of cattle, owing to the large production of beef there. The accomplishment is especially noteworthy since it marks the success, on a county-wide basis, of an activity heretofore limited to progressive individuals or associations made up of specially interested persons.

Forty-three other counties in various States are likewise making outstanding progress and bettering their livestock. In each of those counties 100 or more owners have agreed in writing to use purebred sires for all classes of animals raised. The greater earning power and better selling price of well-bred stock continue to be apparent.

Through arrangements with the management of Sni-a-Bar Farms near Kansas City, Mo., the department obtained and published some of the results of an extensive demonstration conducted for 10 years in the improvement of an ordinary herd of cows by the use of purebred bulls. The marketing data and other results furnish convincing evidence that good breeding is a dominant factor in the production of high-quality beeves and that good feeding and management will not return best results unless the element of good breeding is present also.

### MEAT INVESTIGATIONS

In accordance with plans made during the previous year, important research is now in progress to determine factors which influence the quality and palatability of meat. The experimental work takes into consideration numerous factors, including age, sex, breeding, grade,

and feed. Nineteen States cooperated with the department in the first year's work. In technical studies of the kind undertaken the necessity for accurate measurements was apparent early in the work for determining and expressing quality in meat other than by personal judgment. The development of equipment included machines for measuring color accurately and for determining the tenderness or breaking strength of muscle fibers. Slaughter records in connection with meat research include not only studies of carcass weights, dressing per cent, and quality of meat, but also weight of organs both full and empty, length of intestines, and numerous other details.

### Soft-Pork Problem

Earlier investigations to determine the causes of "soft pork" and the opportunities which may exist for correcting the conditions producing it were continued in cooperation with 13 State experiment stations. The condition appears most noticeably when hogs are fed certain rations, such as those containing peanuts, soy beans, and other oily feeds. Formerly soft pork was regarded as a problem chiefly of the South and dependent in large degree on rations containing peanuts. Developments during the last year's experimental work now show clearly that other feeds, notably soy beans, are likewise important, and that soft pork is a problem to be reckoned with wherever hogs are produced. The experiments are resulting in systems of feeding by which any of the softening feeds may be used to some extent, without necessarily producing soft carcasses.

### ANIMAL PROTEINS

The chemical and physiological studies of meat and meat-food products have furnished new knowledge concerning the nutritive value of proteins in animal tissues. The supplemental value of certain meat proteins to that of vegetables is especially of interest. The protein of beef, for instance, enhances to a remarkable degree the nutritive value of protein in wheat, bolted wheat flour, corn meal, oatmeal, and rice; that is, when consumed in combination with beef proteins cereal proteins are much more efficient for promoting growth than when the latter are fed alone. In the same way certain animal products, such as tripe, calves' sweetbreads, beef blood, and beef serum, which are of low biological value when fed alone, are greatly improved in value when fed with the proteins of beef muscle or beef liver.

Other biological studies have revealed the mode of action of disinfectants. This work, which is highly technical, shows which chemical members of various series of compounds have the chief power of destroying bacteria. Several products studied proved to be of exceptionally high bactericidal power. Research of this kind has its practical uses in the treatment and eradication of diseases and in increasing the effectiveness of disinfectants.

### LIVESTOCK EXPERIMENTS

Three years of experimental work conducted in Texas and New Mexico have shown that calves can be fattened in a comparatively short time on the feeds produced in the Southwest. Experiments



in West Virginia, which apply also to surrounding territory, have shown that cattle to be marketed off grass in the fall can be wintered satisfactorily—so far as gains are concerned—on almost any combination of feeds produced in the Appalachian region. Silage, cottonseed meal, and straw proved to be a more desirable winter ration than hay and grain.

Studies of wool production under western range conditions showed that length of staple is one of the most important factors influencing the weight of wool per fleece. The breed used in these experiments was the Rambouillet, and owners of such sheep should find it profitable to breed for fleeces of longer staple.

A five-years' comparison to determine the advantages of early or late lambing under New England conditions strongly favored the latter. Net profits for ewes that lambed late (May and June) were more than twice as great as for ewes that produced lambs early (February and March). The principal reason for the advantage was the lower cost of feeds. Late lambs and their mothers did well on cheap pasture, whereas the early lambs and their mothers required expensive feed.

### Poultry-Breeding Work

Poultry-breeding work conducted at the department experiment farm at Beltsville, Md., resulted in increased production and a larger proportion of hens which laid 200 eggs or more annually. In poultry-feeding tests the benefit of cod-liver oil in rations of chicks raised in confinement was apparent. Removal of the oil from the rations of such chicks resulted in greatly increased mortality and poorer growth.

An important undertaking of the year in poultry work besides the experimental activities was the formulation and development among States of a uniform plan of accreditation and certification of hatcheries and breeding flocks. The essential purpose of the undertaking is the establishment of inspection and supervision, thereby enabling purchasers of fowls, of baby chicks, and hatching eggs to obtain stock free of disease and of the quality represented. The department also instituted cooperation with the management of official egg-laying contests with respect to the adoption of uniform rules and regulations.

### MEAT INSPECTION RENDERS WIDE SERVICE

Of the various regulatory services which the department conducts for the benefit of the American public, Federal meat inspection is one of the most important and extensive. During the year this service was maintained in 896 establishments in 251 cities and towns throughout the country. It covered the inspection of more than 68,000,000 food animals both before and at the time of slaughter. The supervision extended also to the preparation of a wide range of food products derived from such animals. The service as now conducted extends to about two-thirds of the food animals slaughtered in the United States, the remaining one-third being local or intrastate slaughter not subject to Federal supervision under the Federal meat-inspection law. During the year, Federal inspection of meats made possible the exportation of about  $1\frac{1}{2}$  billion pounds

of meat and meat products to foreign countries which require certificates of inspection. This Federal activity thus aids in furnishing an outlet for a surplus of meats grown on farms and ranches of the United States.

#### **Small Proportion of Condemnations**

The general condition of food animals coming under Federal inspection has been reasonably good, the proportion of entire animals or carcasses condemned being less than one-half of 1 per cent. Parts of carcasses failing to pass inspection were more numerous, amounting to about 1.6 per cent of the number of animals inspected.

Meat-inspection records for the year continue to draw attention to a distressing condition at meat-packing centers, namely, the large number of animals which Federal inspectors find dead or in a dying condition. The numbers of such animals for the year are: Swine, 37,103; cattle and calves, 10,367; sheep and goats, 8,763; making a total exceeding 56,000 head of stock. Besides representing a large loss of meat and food products, the unfortunate condition of the animals entails much suffering and reflects on a branch of commerce which has earned widespread recognition for its highly perfected organization and efficiency in other respects. The total of 56,000 dead or dying animals found at market centers is, of course, a very small proportion of the livestock receipts, but the figure appears to be needlessly large and capable of reduction by the combined efforts of all persons shipping and handling livestock.

#### **Supervision of Biological Products**

The inspection of biological products intended for sale in interstate commerce was attended by a noteworthy increase in the number of certificates which the department issued for their exportation. A total of 467 certificates—more than a third greater than last year—were issued to accompany shipments to 22 foreign countries. These products, which include serums, viruses, and toxins, are important in the prevention, diagnosis, and treatment of various livestock diseases. Federal inspection of their manufacture deals largely with supervision that insures purity and potency. The quality of biological products made under Federal inspection continues to be satisfactory and in conformity with the high standard established for them.

#### **BAIT FOUND FOR PEACH MOTH**

Steady and remarkable progress along many lines has been made by the Bureau of Entomology during the last year. An attractive bait for the peach moth has been found. It has also been found that in its overwintering stages in the soil this destructive insect can be destroyed by two thorough cultivations. Furthermore a thorough study of the life history of the insect in Georgia indicates that the peach moth will not be a serious peach pest there.

The problem of the plum curculio in the peach orchards of Georgia appears to have been solved, although only a few years ago much consternation was aroused by the ravages of this insect.

Because of the general adoption of control measures worked out by entomologists of the department in cooperation with State experiment stations, the Hessian fly has been held to a minimum since 1919, and one of the best wheat crops in years has been harvested this year. The control of the Hessian fly has saved millions of dollars to the wheat growers, both in quality of their product and in yield per acre.

The European corn borer has been held to territory not much greater than that which it inhabited last year. No severe damage has been suffered in the United States. Based upon our thorough investigations of the biology of this insect, agricultural engineers have been able to develop farm machinery which mechanically destroys the corn borer while at the same time it performs the necessary harvesting operations at little or no increased cost. The efforts of the department through the effective cooperation of State organizations in thus retarding the spread of this injurious insect have resulted in the saving of millions of dollars.

A demonstration carried out to determine the effectiveness of the department's recommendations against the rice weevil, in which a small island off the coast of Georgia was the field of operations, has shown that this insect can be controlled economically.

In southern California investigations have shown that, with the proper field control practices, bean-weevil injury can be almost completely eradicated. Heretofore the loss from this insect has been very great, mounting into the hundreds of thousands of dollars.

#### Contact Spray Developed

A satisfactory contact spray has been found which can be used successfully against the Japanese beetle. Better soil insecticides have also been developed for use against the larvae of this destructive insect, and the advantages of geraniol as an attractant for the beetles have been more apparent. It seems probable that the department in its active work in delaying the commercial spread of this pest will have gained the necessary time for the development of control measures before the enormous damage is done which this insect has threatened.

Many thousands of parasites of both the European corn borer and the Japanese beetle have been brought in good condition from Europe and the Orient, and from Europe department experts have also sent parasites of the alfalfa weevil, the European earwig, and the European elm-leaf beetle.

The Gipsy moth has been held within its old boundaries of spread and the large New Jersey colony of the insect is under thorough control and approaches extermination.

Poison dusting from airplanes has been effective against the cotton boll weevil and the cotton leaf worm and is now being tried out with considerable success against the alfalfa weevil.

An extraordinary outbreak of the cotton flea hopper occurred in the early summer of 1926 and great damage was threatened. Investigation showed that a fair degree of control may be reached by the proper use of sulphur on the cotton plants.

White ants or "termites" cause millions of dollars damage to the wood of buildings each year. Methods of control have been



formulated and specifications prepared for use in the creation of termite-proof buildings. These plans have been placed before municipal engineers for adoption in their building codes.

An important result of careful studies is the finding that the western pine beetle has a tendency to select the slower-growing trees. This shows a possibility of eliminating the susceptible trees through selective logging operations.

### INVESTIGATIONS IN MILK PRODUCTION

Increasing the efficiency of dairy cows so that the same amount of milk and butterfat can be produced from fewer cows at less cost is the quickest way of increasing the net income of the American dairy farmer. The average yearly production of butterfat per cow in this country is about 180 pounds. This is much too low. With such an average it is apparent that many farmers are not realizing a profit from the dairy business. Investigations by the department point to the possibility of increasing this average perceptibly within the next few years by laying special stress on certain fundamentals in dairy-herd management.

It has been found that the inherent ability of cows to produce milk varies to a great extent. One cow of certain parentage may possess the ability to produce large quantities of milk and butterfat economically, whereas another from the same parents may be entirely lacking in this ability. Another problem is that of the proper feeding of dairy herds. Why does one cow utilize feed to better advantage than another? Why does one kind of feed produce better results than another? The problems of dairy cow nutrition which involve not only the protein, carbohydrates, and fats in the feed, but also the calcium, phosphorus, and other minerals, as well as vitamins, are far from being solved.

Investigations now underway in the Bureau of Dairy Industry deal directly with these problems. Results so far indicate that through the finding of dairy sires that are pure for the transmission of high milk and butterfat production, it will be possible to mate animals so as to be reasonably sure the offspring will be high producers. These pure sires are being located through the testing of large numbers of cows and their daughters. When all the daughters of one bull invariably produce more than the dams of those daughters, almost regardless of how low or how high the production of the dams may be, it seems highly probable that this sire may be pure for the transmission of high production. Such a bull would be regarded as a proved sire and should be kept in use as long as he is serviceable. Many such bulls have been found and in finding them many inferior bulls have likewise been located. There is as much advantage in destroying the latter as in making the fullest use of the former.

### Great Dairy Improvement Possible

Great improvement in dairy herds can be accomplished through a more general use of purebred sires. Fewer than half of the dairy bulls now in use are purebred. By eliminating scrub bulls and replacing these with purebreds, a distinct advance can be made in

increasing dairy production. The department is now undertaking to extend the use of purebred dairy bulls through cooperative bull associations and through organized scrub bull eradication campaigns.

Improvement in dairy production is also possible through better feeding of dairy cows. This includes the balancing of the ration so as to furnish not only sufficient protein, carbohydrates, and fat, but also mineral matter and vitamins. It has long been known that heavy milking cows need an abundance of mineral matter in their diet. This may be supplied through the proper selection of feeds, and the use of a liberal amount of legumes. However, it makes a difference how these legumes are cured.

Investigations by the department show that when cows get brown stemmy alfalfa which has been exposed to the rain or to too many days of hot sun, they often can not assimilate more than 5 per cent of the lime contained in it. Accordingly, they must draw on their bones for a large part of the lime needed in their milk. This results in decreased milk production, and possibly difficulties in rearing their young.

On the other hand, when cows get green leafy alfalfa which has been cured without getting wet by the rain and without too much exposure to the sun, they are able to assimilate about 20 per cent of the lime contained in it. They do not need to draw on the lime contained in their bones in order to supply what is needed for the milk or for reproduction.

Another closely related problem concerns uncertain breeding and temporary sterility among dairy cows and heifers. To determine whether or not this condition was caused by a shortage of vitamins in the ration, shy breeding cows and heifers were fed fairly large quantities of sprouted oats and wheat germ, these two feeds having been reported to contain vitamin E in abundance. After receiving sprouted oats for periods ranging from 10 to 114 days, a number of such animals were pronounced pregnant.

#### Utilization of Dairy By-Products

It is imperative that more attention be given to the efficient utilization of the by-products of butter and cheese manufacture. Over 28,000,000,000 pounds of skim milk, buttermilk, and whey is produced in this country each year. Of this amount 22,000,000 pounds is skim milk from the manufacture of butter. In this great volume of by-products is nearly 900,000,000 pounds of protein and 1,400,000,000 pounds of milk sugar. All of this is in a form available for human food, but under the present conditions the greater part of it is fed to farm animals. Although by this means it is converted into human food in a different form there is a very material loss in the process. The 2,500,000,000 pounds of edible dry matter in the dairy by-products fed efficiently to hogs would be converted into only 400,000,000 pounds of edible dry matter in the form of pork, or if fed to chickens would produce only 110,000,000 pounds in the form of poultry.

The department is undertaking investigations which are planned to reduce this loss by converting skim milk, buttermilk, and whey into convenient form for combining with other foodstuffs. Special attention has been given to the properties of dry skim milk in bread making and to methods of utilizing the proteins of whey. A process

has been developed and established in commercial practice for converting skim milk into a stable product which can be used efficiently for poultry feeding. It is hoped, however, that eventually the uses of skim milk in human food may be developed so fully that only the small part essential to the proper development of young animals will be retained on the farms.

### DUST-EXPLOSION PREVENTION

Progress was made in work to prevent dust explosion in industrial plants. Dust-explosion regulations have been developed in cooperation with the National Fire Protection Association for flour and feed mills, sugar-pulverizing systems, cocoa-pulverizing systems, pulverized fuel installations, terminal grain elevators, and starch factories. These regulations embody the precautionary measures developed for the prevention of dust explosions and fires in representative industrial plants. The regulations have been adopted by the National Fire Protection Association and also by the National Board of Fire Underwriters, and have become the standards for insurance and State officials.

The development of the use of inert gas for the prevention of dust explosions is an achievement which should prove of particular interest to manufacturers of dusty products who have a dust explosion hazard in their plants. Feed manufacturers will benefit particularly from the work of the past year because the first tests and demonstrations have been made with feed-grinding equipment. Although it has been known for years that inert gas could be used to extinguish or prevent fires, the actual application of the principle had not, so far as is known, been tried with feed-grinding equipment.

#### Inert-Gas Method in Use

Equipment to provide inert gas for preventing explosions during the grinding of sulphur and hard rubber is already in actual operation in a number of plants and the tests made in the department during the past year indicate that it will be possible to provide in practically all feed-grinding plants insurance against dust explosions by means of inert gas.

The presence of static electricity on belts and operating equipment is a great dust-explosion hazard. It is one of the most difficult hazards to control, and up to the present time no satisfactory mechanical method has been developed to prevent its formation. Electrically-grounded combs and brushes on belts merely dissipate the charge after it has been formed and increase the hazard if the ground wire were to become broken. For this reason no grounding method for static electricity can be regarded as an absolutely effective control measure. Encouraging results are being obtained in tests on a waterproof, dry surface, rubber-belt composition. Laboratory tests on a leather-belt dressing have been so successful that plans are now being made to try it out on an industrial scale.

### DETECTING FROZEN ORANGES

Research work was conducted to determine the chemical changes that take place in oranges during freezing in order that methods



may be developed for detecting and separating out the frozen oranges. It is highly important both for the producer and the consumer that frozen fruit be eliminated before shipments are made to market. Unfortunately, frozen oranges can not be detected merely by inspection. If some certain method for sorting out all frozen oranges can be devised, it will be of immense benefit to the fruit-growing industry and also to the consumer. If separated out in time at point of production, the frozen oranges can be used in the manufacture of by-products.

### DETERMINING MATURITY OF FRUITS

One pressing problem confronting the growers of fruits is to know at exactly what stage of maturity to pick the fruit in order that it may reach the market in the best possible condition. If the fruit is picked too early it never attains its finest flavor and the market for the fruit is impaired by the unsatisfactory flavor. On the other hand, if the fruit is not picked until too late it is very likely to start deteriorating before it reaches the consumers.

Losses from this cause are especially large when the fruit is shipped long distances. It is not practicable to determine by physical examination alone when the fruit has reached that degree of maturity which is best for picking. Some chemical test is necessary. The Bureau of Chemistry laboratory at Los Angeles has made a study of the chemical factors that are affected by degrees of maturity in various fruits in order to devise tests by which the growers can determine when the fruit should be picked.

In previous reports the results of work on tests to determine the maturity of cantaloupes and oranges have been outlined. These tests for maturity have been applied commercially to oranges for a number of years and to cantaloupes for two or three years. They have saved growers from great losses. During the year work has been completed on maturity standards for raisins and the results published. A tentative standard has been worked out for maturity in pomegranates and has been tested through one crop. Work to develop maturity tests for other fruits is under way.

### CHEAPER EMULSIONS FOR CONTROLLING INSECTS

Lubricating oil emulsions and miscible oils are used principally for the control of San Jose scale, citrus white fly, and citrus scale insects. In recent years their use has increased greatly. The formula for making lubricating-oil emulsions, which is now most generally employed, requires heat or a large proportion of soap. In the preparation of the boiled emulsion the use of heat is both time-consuming and expensive, and in the case of the cold emulsion formula, calling for the increased proportion of soap, the cost of the product is greatly increased.

As the result of a comparative study of this problem by the Bureaus of Chemistry and Entomology, a modification of the method of making cold-mixed emulsions was developed which gives a product that is apparently as stable and as effective as the best boiled emulsions, and one that can readily be made by the orchardist. The proportion of soap is the same as, or less than, that used in the pres-

ent formula for boiled emulsions, so that the cost of the product is materially decreased. This emulsion may be made and shipped in paste form containing only 8 per cent of water. The packing and shipping charges will thus be much less than if the ordinary concentrated emulsion were shipped. Last spring one grower made and used several thousand gallons of this product against San Jose scale with satisfactory results.

A soap-cresol-oil emulsion was also developed which contains less cresol, the most expensive ingredient, than the usual miscible oil and is therefore less expensive. When diluted for spray use it has the small-drop size and stability in hard water characteristic of miscible oils, and spraying experiments indicate that it is equally as toxic to insects as the product made by the old formula.

### NUTRITIVE VALUE OF WHEAT BRAN

Previous studies on the proteins of wheat bran conducted in the Bureau of Chemistry have shown that these proteins differ essentially from the corresponding proteins of the other parts of the wheat kernel. They contain much larger quantities of the so-called nutritionally essential amino acids than are contained in the endosperm proteins. Wheat bran contains more than twice as much of these important amino acids as are present in the same weight of white flour.

In the light of these results obtained from a chemical investigation of the proteins of wheat bran, feeding experiments with albino rats were undertaken to further study the nutritive value of the bran proteins, and also to ascertain to what extent these proteins are available for assimilation when animals are fed, not the isolated proteins, but the crude bran.

Although wheat bran has long been recognized by practical feeders of animals as having high nutritive value, nevertheless there has been almost no experimental work done to determine the nutritive value of the proteins of wheat bran in which the bran supplied all the protein in the diet. It is generally conceded that bran is fairly well digested by ruminants which have digestive tracts adapted for the accommodation of coarse, bulky material such as hay and fodder. As for its food value for animals other than ruminants, particularly as a food for man, many conflicting views are expressed, ranging from the statement that bran is wholly without food value to statements that it is an excellent food, and that it is digested by man as well as by domestic animals.

#### Bran Well Utilized

The feeding experiments, in which about 70 albino rats were used, have shown that the proteins of bran are well utilized by rats and that the ability to digest the proteins in crude bran is not limited to ruminants as is frequently asserted. Rats have lived for nearly two years, a period which corresponds to about two-thirds of the normal span of a rat's life, on a diet containing no protein other than that supplied by crude bran. During the period of early growth they grew at a rate better than normal, but after arriving at the early stages of maturity, development practically ceased.



In a similar diet in which the protein was furnished by white flour instead of bran the animals gained during the first 100 days only one-half to two-thirds as much as the rats on the bran diet. Those receiving the white flour grew slowly, yet their rate of growth was so uniformly maintained that at the end of 254 days most of them weighed even more than did the rats that had been receiving the bran diet for the same length of time.

It appears that wheat bran contains in abundance certain factors required for the growth and development of young animals, but does not satisfactorily meet the animal's nutritional requirements after it has reached maturity. Rats fed the bran diet have produced offspring, but they had little success in rearing them. Fecundity was low. The high efficiency of the bran ration for promoting early growth, and the less satisfactory results obtained with it in connection with subsequent growth and reproduction are a striking example of how the nutritional requirements of an animal vary with the changing stages of development coincident with advancing age. This also emphasizes the need of giving consideration to this phase of nutrition in connection with the practical feeding of domestic animals for animal production.

#### THE FEDERAL FOOD AND DRUGS ACT

Progress was made in promoting the purity and truthful labeling of food and drugs through the enforcement of the Federal food and drugs act. This year is the twentieth anniversary of the enactment of the law. The department looks upon this act as a corrective measure rather than a punitive one and, in enforcing it, endeavors to render assistance to the industries in improving their products. For instance, a survey made a few years ago revealed that canned blueberries from Maine contained excessive quantities of maggoty berries. Several shipments of these were seized in various parts of the United States. The canners and growers of blueberries thought it impossible to reduce materially the quantity of maggots in blueberries. The blueberry-canning industry was threatened with ruin, since maggots in canned food constitute a violation of the food and drugs act. Blueberries are the chief crop of one county in Maine, and the livelihood of many people was threatened.

Staff specialists were sent from the department to study the situation, in collaboration with officials of Maine. As a result of the study, an apparatus was devised by means of which it is possible to eliminate the maggoty blueberries. The first season after this device was invented, it was used by a few canners with marked success. The next season, a still larger number used it and put up a product that met the requirements of both Federal and State food laws. Practically all of the principal canners have now adopted means that insure a legal product. Federal and State food inspectors patrolled the canneries to assist in eliminating maggoty berries and to see that the canned product met the requirements of the law. The educational methods followed by the Federal and State food officials have been effective both in saving an industry from great losses and in enabling consumers to obtain an unobjectionable product.



### Deterioration in Sardines

Inspection of the sardines packed in Maine in previous years revealed that a considerable portion of fish which had undergone a form of decomposition known as "belly blown" was included in the pack. Numerous shipments of decomposed sardines were seized and extensive educational work to demonstrate methods for putting up a good pack was carried on. A survey was made to ascertain if educational work done among the sardine packers during the last few years had been effective. Packing plants were visited five or six times. It was found that the educational and regulatory campaigns had accomplished commendable results. Notwithstanding rather comprehensive sampling, no goods of last season's pack were found of a character warranting action under the Federal food and drugs act.

When individual concerns persist in violating the law, or when violations involve deliberate fraud either through adulteration or misbranding, the full penalties of the law are invoked to correct the trouble. For several years a bad situation existed in the salmon-canning industry in that a few canners persisted in putting up decomposed fish. An extensive campaign was carried on to stop this practice. Several seizures were made and a number of hard-fought contests in the courts resulted ultimately in verdicts for the Government. This has demonstrated to those packers who are not disposed to put up a sound and wholesome pack that it is incumbent upon them to revise their methods of operation and market an article which will comply with the law. The department has had the whole-hearted support of the better element of the industry, which through pressure on offending members has assisted in the process of reform. Examination of a large number of shipments of canned salmon during the last season has shown that great improvement has been made in this industry, and that the great bulk of the canned salmon shipped in interstate commerce now meets the requirements of the law.

### VITAMIN CONTENT OF OYSTERS

Notwithstanding the fact that oysters constitute the most valuable fishery product of the United States, nothing previously has been ascertained regarding their content of vitamins A, B, and D. Work was therefore undertaken to determine the value of oysters with reference to these diet factors. An additional interest is connected with this investigation inasmuch as a large part of the food of oysters consist of diatoms and minute organisms—marine forms of life to which have been traced the origin of the fat-soluble vitamins found so abundantly in certain fish liver oils, such as that of the cod.

Fresh, medium-sized oysters obtained in the open market were frozen and ground. Graduated dosages of the frozen material were tested for its vitamin content by means of feeding experiments with albino rats according to methods in general use for vitamin determinations. The results of these experiments show that oysters are rich in vitamins A and B. Quantities of fresh oyster equivalent to half

a gram, calculated on a dry basis, caused prompt resumption of growth when fed daily to rats that had declined in weight as a result of deficiency of vitamin B in their ration. Even smaller quantities were found to practically meet the requirements of rats for this vitamin. Similar quantities of oysters have been efficacious in curing an eye disease in rats caused by a deficiency of vitamin A.

### MANUFACTURE OF SIRUP AND SUGAR

Work was continued on a procedure for producing unsulphured cane sirup of good quality from low-purity cane juice. Important progress was made. This work will permit heavy milling and greater extraction of juice in the manufacture of this type of cane sirup and will reduce the loss resulting from low juice extraction. When used in conjunction with sugar production it will be possible to use the higher-purity juice for sugar, the lower-purity juice representing higher extraction being used for making sirup. This will make for greater economy in the commercial utilization of sugar cane under domestic conditions.

As a part of this investigation, a method for producing a new product called "cane cream" has been devised and production of this product on a semi-factory scale will be undertaken during the season of 1926. Cane cream, which is also made from lower-purity juice, has a consistency similar to that of confectionery fondant, with a characteristic cane flavor. It can be made of widely varying consistency, and can be used in a variety of ways, such as in sandwiches, on griddle cakes, and in preparation of cake icing. The cost of manufacture is moderate, and the use of lower-purity juices for producing cane sirup and cane cream will make possible greater efficiency and economy in the manufacture of sugar from higher-purity juices when used in conjunction therewith. The fabrication of these products is part of a general plan for the production of specialties which is believed to be of great economic importance for the cane-sugar industry.

Considerable progress was made in an investigation of the fundamental conditions governing clarification of cane juice in the production of raw and plantation granulated sugar. Because of lack of full understanding at the present time of the various factors which control clarification of juice, the elimination of nonsugar substances from juice in sugar manufacture is conducted with a varying degree of efficiency, and the maximum clarification possible is far from being consistently attained. It is known that the exact combination of conditions required for maximum clarification of cane juice varies greatly, depending on such factors as variety of cane, soil, kind of fertilizer used, degree of maturity of cane, whether the cane has been burnt or not, and length of time the cane has been cut. Methods are being devised whereby the juice can be tested from time to time and suitable adjustment made in clarification conditions, so as to obtain uniformly the maximum efficiency possible with the clarification process used.

A method has been worked out whereby the clarification of acid digestion liquors in the manufacture of glucose and corn sugar may



be considerably improved. This is of much importance, in view of the fact that uneliminated colloidal substances interfere with the growth of corn-sugar crystals. If the crystals are too small, difficulty is experienced in separating them from the mother liquid by centrifuging. Greater elimination of colloidal substances is therefore desirable, corn sirup of greater clarity resulting. This improvement is of distinct benefit to the rapidly growing corn-sugar industry, which in 1925 produced almost 600,000,000 pounds of this sugar.

### FEDERAL-AID ROAD CONSTRUCTION

Continuing the Federal-aid road work, which has now been in progress for 10 years, the department, cooperating with the several State highway departments, brought to completion during the last fiscal year road-building projects involving the improvement of 9,417 miles. This brings the total mileage improved with Federal aid during the 10-year period up to 55,903 miles.

At the close of the fiscal year construction was in progress on 10,962 miles, and projects involving 2,470 miles had been approved for construction. Thus the cooperating Federal and State authorities have so far undertaken or completed the improvement of 69,335 miles, all of which, with the exception of a few hundred miles completed prior to 1921, is included in the interstate system of 182,135 miles known as the Federal-aid highway system, designated in that year in accordance with the Federal highway act.

The Federal-aid highway system is a real interstate system, designated in the first instance by the several State highway departments and approved by the Federal authority. The manner of their designation by those whose knowledge of traffic conditions is most intimate justifies the presumption that the roads constituting this system are the most important through highways in the country. Nearly a third of this important system has already been improved to a degree commensurate with present traffic demands under the Federal-aid plan, and the work currently in progress will raise the proportion well beyond a third. As reports of the State highway departments indicate that at least an equal mileage has been improved by the States without Federal assistance, it is probable that nearly three-quarters of the system is already improved or in course of improvement.

Ten years ago when the Federal-aid road work was begun there were only five States in which there was an improved road across the State. To-day 25 States have continuously improved highways entirely across them in at least one direction and 16 of these have completed such trans-State arteries in two directions.

### Status of Transcontinental Roads

A recent survey of the status of improvement of the Federal-aid highway system shows that there is now one transcontinental road which is 97 per cent improved. This is the road from Washington through St. Louis, Texarkana, and El Paso to San Diego. Of other roads crossing the continent one which runs from Atlantic City to Astoria is seven-eighths improved; another from Norfolk to Los



Angeles is 68 per cent improved; and one from Boston to Seattle is 73 per cent improved.

It is the primary purpose of the Federal-aid highway legislation to expedite the improvement of such interstate roads; and the rapid progress that has been made in the last 10 years toward that end is in large part the result of the Federal participation.

The projects completed during the fiscal year 1926 include 2,161.3 miles of roads graded and drained, 627.3 miles surfaced with sand-clay, 3,274.1 miles surfaced with gravel, 58.2 miles of waterbound macadam, 553.2 miles of bituminous macadam, 179.6 miles of bituminous concrete, 2,464.3 miles paved with Portland cement concrete, and 78 miles with brick. These with the bridges completed, aggregating 21.3 miles in length, make up the total of 9,417.3 miles completed during the year and added to the length of the corresponding types completed previously bring the total up to 55,902.8 miles, as shown in the following table:

*Mileage of Federal-aid roads completed up to June 30, 1926, by types of construction*

Type of construction	Miles completed to June 30, 1926	Type of construction	Miles completed to June 30, 1926
Graded and drained.....	9, 653. 6	Portland cement concrete.....	11, 976. 5
Sand-clay.....	4, 926. 2	Brick.....	752. 0
Gravel.....	22, 547. 3	Bridges.....	121. 5
Water-bound macadam.....	1, 123. 3	Total.....	55, 902. 8
Bituminous macadam.....	3, 176. 3		
Bituminous concrete.....	1, 626. 1		

### Cost of Completed Roads

The total cost of the roads completed during the fiscal year was \$206,139,220, of which the Federal Government paid \$90,294,107. These sums were expended on the 9,417 miles of new construction and on 1,193 miles of roads previously improved to raise the type of the prior improvement in accordance with traffic demands. The total Federal disbursements to the States during the year amounted to \$87,754,534. This was the amount paid for work on all projects during the year.

The total of Federal-aid funds apportioned to the States from July 11, 1916, to June 30, 1926, was \$671,375,000 which is \$3,686 for each of the 182,135 miles included in the Federal-aid highway system. That the apportionment per mile of the system to the States of the several geographic divisions is substantially in accordance with the relative need for highway improvement as expressed by the number of motor vehicles per mile of the system, and with the relative character of the Federal-aid roads that have been constructed as indicated by the percentage of high and intermediate type surfacing, is shown by the following table:

*Relation of Federal-aid apportionments and motor vehicles per mile of Federal-aid system and percentage of high and intermediate type surfaces constructed in the several geographic divisions*

Geographic division	Average apportionment per mile of Federal-aid system	Number of motor vehicles per mile of Federal-aid system	Percentage of high and intermediate type surfacing
Middle Atlantic.....	\$7, 165	343	98.3
New England.....	5, 175	223	75.8
East North Central.....	4, 240	187	71.9
Pacific.....	4, 186	193	36.7
East South Central.....	3, 810	61	28.2
South Atlantic.....	3, 793	85	38.7
Mountain.....	3, 705	32	10.2
West South Central.....	3, 187	74	27.8
West North Central.....	2, 475	62	14.3

### FOREST-HIGHWAY CONSTRUCTION

Within and adjacent to the national forests there have been designated as forest highways 13,459 miles of important roads, of which 10,954 miles are in the 11 States of the Mountain and Pacific groups.

Approximately 8,041 miles of these highways which either coincide with or are possible extensions of the Federal-aid highway system are designated as class 1 or class 2 highways according as they lie entirely within the forests or extend to outside towns. The remaining highways, including about 5,418 miles, are largely of local service and are designated as class 3.

Particularly in the Western States the forest-highway construction has been an important adjunct of the Federal-aid road work. As the national forests lie in general along the mountain ranges, the improvement of highways across them is necessarily expensive because of their rugged topography, their inaccessibility, and the shortness of the working season. Yet these forest links constitute vital connections in the main transcontinental and interstate routes, especially where they occupy the principal mountain passes. By virtue of these conditions the liberal appropriations made by Congress for road construction in the national forests are of importance not only in the development and protection of the forest areas and their immediate locality but are of benefit to the entire country, in that they make possible the construction of essential interstate and transcontinental highway connections.

The mileage of forest roads brought to completion by the Bureau of Public Roads during the fiscal year was 622.5 miles, which added to that previously completed brings the total at the close of the year up to 3,045.6 miles. These figures are subdivided by States in the following table:

*Mileage of forest highways completed by Bureau of Public Roads, by States*

State	Com- pleted during the fiscal year 1926	Com- pleted up to the close of the fiscal year 1926	State	Com- pleted during the fiscal year 1926	Com- pleted up to the close of the fiscal year 1926
	<i>Miles</i>	<i>Miles</i>		<i>Miles</i>	<i>Miles</i>
Alaska.....	30.7	146.4	New Mexico.....	44.3	164.1
Arizona.....	89.2	216.6	North Carolina.....	-----	16.4
Arkansas.....	2.3	56.8	Oregon.....	-----	464.9
California.....	56.4	202.6	South Carolina.....	133.5	5.3
Colorado.....	32.1	211.4	South Dakota.....	-----	34.8
Florida.....	6.2	64.2	Tennessee.....	-----	12.2
Georgia.....	-----	8.6	Utah.....	16.3	259.0
Idaho.....	44.4	383.6	Virginia.....	-----	6.5
Minnesota.....	19.4	34.6	Washington.....	29.6	184.1
Montana.....	66.9	303.3	Wyoming.....	39.6	173.8
Nevada.....	9.4	94.2			
New Hampshire.....	2.2	2.2	Total.....	622.5	3,045.6

**HIGHWAY RESEARCH**

For the better discharge of its obligations in connection with the administration of the Federal-aid and forest-road work the department has conducted for a number of years a series of researches into the design and construction of highways, the economics of highway transportation and construction, and the materials of construction best suited to resist modern traffic. The department has taken the lead in this field of research and its efforts, supplemented by those of the State highway departments and engineering experiment stations, have laid the foundation for the rational and economical methods of highway administration, design, and construction that have been developed within the past five years.

**ALKALI-RESISTANT CONCRETE PIPE DEVELOPED**

After five years' research in cooperation with the University of Minnesota and the State department of drainage and waters, methods have been developed by the use of which concrete drain pipe can be made that can be satisfactorily used in alkali soils in which the content of sulphate of magnesium and sodium is less than 2,500 parts per million. With extreme care in manufacture, even more severe conditions can be satisfactorily overcome. This work of the department and its cooperators makes possible the use of concrete tile for farm drainage in large sections in which previously the use of concrete pipe has been impossible because of deterioration resulting from attack by alkali.

**EXTENSION WORK**

At the end of the fiscal year 4,965 persons were engaged in cooperative extension work, of whom 3,513 were located permanently in the counties. Of these, 2,221 were employed as county agricultural agents or assistant agents, 882 as home demonstration agents, 135 in boys' and girls' 4-H club work, and 275 in negro extension work. These county workers were assisted by 764 full-time and 218 part-time subject-matter specialists located at the State agricultural colleges. Supervisors, assistant supervisors, and administrative officers



numbered 470. Funds from all sources available for cooperative extension work during the fiscal year 1925-26 amounted to \$19,853,726, an increase of about \$240,000 over the previous year. Of the total funds, 62.2 per cent was allotted for extension agents in the counties; 5.7 per cent at the State agricultural colleges for administration; 10.8 per cent for supervision of county extension forces; 19.5 per cent for the employment of subject-matter specialists to supplement the county workers; and 1.8 per cent for activities of the Federal Extension Service in general supervision, administration, and coordination.

Farmers and farm women conducted about 770,000 extension demonstrations, and farm boys and girls in 4-H clubs about 590,000, a combined increase of about 225,000 demonstrations over the previous year. Improved practices were adopted on farms and in farm homes in nearly 4,000,000 instances during the year as a result of extension influence. More than 200,000 farmers and farm women gave valuable aid to the paid extension staff as volunteer local leaders in the promotion of extension activities. Effective training for extension agents and volunteer local leaders was emphasized during the year. Increased attention was given to the development of a wholesome and attractive life in the open country.

The department continued to cooperate with the State extension services in studying the effectiveness of various phases of extension work in the field. The studies made in 1923-24 in typical areas of seven counties of four States indicated that extension effort had brought about the adoption of one or more improved practices on three farms out of every four and that, on the average, 3.4 improved practices were adopted on each farm reached. These studies were broadened during the year to include special surveys of junior extension work in Massachusetts, local leadership in New Jersey and South Dakota, negro extension work in Georgia and Arkansas, and alfalfa extension in Wisconsin.

#### Progress in Smut Control

Outstanding work was done during the year by extension plant pathologists in influencing farmers to adopt the copper carbonate treatment for the control of stinking smut of wheat. Twenty-five States reported successful results in the use of copper carbonate in preventing loss from this fungus. One State found the treatment so satisfactory that about 90 per cent of the total wheat acreage was sown with treated seed.

Under the Clarke-McNary reforestation act, \$50,000 was available during the year for assisting farmers in the management of woodlands, the reforestation of waste lands, and the more satisfactory utilization of woodlot products. This fund has been allotted to the State extension services at the rate of \$1,500 to each State providing at least an equal amount for the employment of an extension forester. At the end of the year 25 States were cooperating on this basis.

In home demonstration work the number of demonstrations conducted by farm women increased 36 per cent over the previous year. Clothing, foods, nutrition, home management, house furnishings, and home health and sanitation were leading lines claiming the time

and attention of extension workers with farm women and girls. In addition to productive and management activities, opportunities for recreation and self-development were sought and created by farm women through their extension organizations. This was evidenced by the numerous community and county recreational and social events which were held, such as contests, camps, and pageants.

### BOYS' AND GIRLS' CLUBS

One of the important functions of the State agricultural colleges and the department is to keep farm boys and girls in touch with the best in rural life and develop leadership, community responsibility, and good citizenship. This is largely accomplished through 4-H clubs organized by the extension service. In 1925 there were 41,286 of these local clubs in which 565,046 farm boys and girls were enrolled. The largest enrollments were in work with poultry, corn, swine, cotton, home gardening, dairy cattle, clothing, food preparation, nutrition, beautification of home grounds, food preservation house furnishings, and home health and sanitation.

Large as this enrollment is, only one in twenty rural boys and girls between the ages of 10 and 18 is receiving the instruction, training and helpful guidance to which all are entitled. Many farm boys and girls are not attending school. To reach a larger proportion of the boys and girls in the country, a program for the systematic development and expansion of 4-H club work has been adopted. This program contemplates encouraging county agricultural and home demonstration agents to interest more boys and girls in 4-H club activities where this is possible without decreasing their work with adults, or to employ an assistant agent or club agent to give their full time to farm boys and girls.

Agricultural exhibits were presented during the year at 46 State and interstate fairs, and at about a dozen minor exhibitions. A large and comprehensive exhibit of the various activities of the department was prepared for presentation at the Sesquicentennial International Exposition in Philadelphia, a special appropriation having been made available for that purpose.

### NEW MOTION PICTURES MADE

The department is making large and satisfactory use of motion pictures in presenting many phases of its work to the public. Approximately 25 new pictures have been made each year for the last few years, and the department now has films in circulation on more than 200 subjects. The Office of Motion Pictures has available 1,485 copies of the various department films, many of which are in constant use by its extension and research workers. Some of the most effective work in promoting campaigns for the eradication of plant and animal diseases, such as white-pine blister rust, bovine tuberculosis, and the southern cattle tick, has been done through the use of motion pictures. In the tick-eradication campaign two motor trucks equipped with projection apparatus have been constantly engaged in presenting the advantages of tick eradication in rural communities, in many of which motion pictures have not been previ-



ously shown. This work has been so effective in creating favorable sentiment that plans are now under way for the making of a new motion picture on tick eradication, those previously made having been so widely shown that new material is needed.

For the past few years demonstrators have been at work on several of the Federal reclamation projects, particularly for the purpose of encouraging livestock production. These men have been maintained entirely from Federal funds, but during the last year arrangements have been made with State extension officials for their cooperative employment, in most instances as members of the State extension service. This plan has served to coordinate their activities with those of other extension workers and has brought to the reclamation projects the additional services of specialists from the State colleges of agriculture. Funds released by the taking over of portions of salaries and expenses by State and county agencies have been utilized in the employment of extension agents on additional projects where this service has been much needed. The demonstrators in the past have been very helpful in promoting the development of dairying, poultry raising, the production of sheep and swine, the growing of forage and pasture crops, and the giving of advice on other agricultural problems. A notable example in the development of dairying is found on the Newlands project in Nevada.

### THE PURNELL ACT

Striking testimony of confidence in the efficacy of organized agricultural research was afforded by the passage of the Purnell Act for the more complete endowment and maintenance of the State agricultural experiment stations, which went into effect July 1, 1925, and added \$960,000 to the \$1,440,000 previously received by the stations through the Hatch and Adams Acts, and will ultimately (in 1930) increase the Federal endowment of the stations to \$4,320,000 annually.

During the first year of the operation of the Purnell Act over 600 new research projects dealing with problems of primary importance to agriculture and rural life were successfully undertaken by the stations with notable broadening and strengthening of their field work and improvement of the cooperative relations of the department and the stations.

The Purnell Act was the first Federal legislation to give explicit authority for work by the experiment stations in agricultural economics, rural sociology, and home economics. The stations had previously done a considerable amount of substantial research in these fields, but lack of means and trained personnel had prevented the development of such research to the extent that its importance merited.

### Research in Economics

While not neglecting the fundamental questions of efficient production, the newer work recognizes more fully the importance of finding solutions for the economic and social problems of the farm and the farm home. Clear evidence of this is found in the fact that half of the new projects undertaken under the Purnell Act deal with



such problems. It is believed that the better-balanced program of research thus made possible will contribute to greater efficiency and profit in the operation of the farm and to the development of a more satisfactory rural home life. Altogether, the first year's experience under the new act has been very satisfactory.

The expectation that the operation of the Purnell Act would lead to a considerable expansion of the already large cooperative relations between the stations and the department, especially in the relatively new fields of agricultural economics, rural sociology, and home economics, has been fully justified. The department and the stations are now cooperating in approximately 500 formal projects and in a large number of less formal ways. This means more efficient, less wasteful, and more speedy methods of attacking, and finding practical solutions for, some of the larger problems affecting farming and the farm home.

### NITROGEN FIXATION

During the last year contact with the nitrogen-fixation industry has been maintained by the Fixed Nitrogen Research Laboratory. The industry has been served through the usual channels of publication, and the laboratory has been conducting various investigations in order to furnish further fundamental data.

A number of technical men have left the department to enter the synthetic ammonia industry.

Progress in nitrogen fixation in the year 1925-26 has been encouraging. About half a dozen industrial plants are now in operation in various parts of the country and others are planned or under construction. The combined capacity of these plants is now nearly sufficient to furnish all of the ammonia needed in the country for the refrigerative and chemical industries. The point appears to have been reached where the decision must soon be made as to whether this industry will expand into the field of nitrogen fertilizer on a large scale. While this step encounters competition from by-product ammonia, agriculture seems likely to profit by this competition through price reductions.

A synthetic-ammonia plant, mentioned in the last annual report as having been installed to use the process developed at the Fixed Nitrogen Research Laboratory has now been in full operation for more than a year. The mechanical design as well as the catalyst and other features have proved satisfactory. While cost data have not been available, it is estimated that the cost of production has been low.

### Making Ammonia Fertilizer

The laboratory has continued during the present year to investigate the important subject of urea synthesis. Now that it is known that ammonia can be synthesized at a favorable cost, the next most important step is to be able to convert it economically into one of the various forms suitable for fertilizer use. Urea is one of the most attractive of the possibilities, since carbonic acid, the only other chemical needed besides ammonia, can be very cheaply obtained. The problem consists in working out a continuous process that will be sufficiently economical. The investigation is still in the

stage where the different unit operations are being studied, and it is too early to predict what the result will be when the entire cycle is put into operation.

The engineering division of the laboratory has just completed the design of a laboratory compressor to operate at 1,000 atmospheres. The compressor will be used in studying catalytic processes at very high pressures.

### FIRE-WEATHER FORECAST SERVICE

Weather is a factor of large importance in the preservation of forests. Fire is the greatest menace to forestry and losses each year from this cause are enormous. Information in advance of weather conditions tending to the inception and spread of forest fires or to the putting out of fires already in progress is of inestimable value to protective agencies of the forests by enabling them to increase lookouts, assemble fire-fighting forces, and take other measures to stop any fires that may start.

In recognition of the need for an intensive fire-weather forecasting service a special appropriation, a part of it becoming immediately available, was made by Congress during its last session for the organization of such a service in some of the large forested sections of the country. To that end a conference, participated in by officials of the Weather Bureau, the Forest Service, State forestry organizations, and representatives of privately owned forests, was held in April at Portland, Oreg., to devise plans for the work. This purpose was accomplished and fire-weather warning districts were established for California, Oregon, Washington, northern Idaho and Montana, and southern Idaho, with headquarters, respectively, at San Francisco, Portland, Seattle, Spokane, and Boise. A trained meteorologist and forecaster was assigned to each district and arrangements made for providing service before the advent of the summer fire-hazard season.

Additional meteorological substations were established in the forests from which weather reports were obtained daily for use in connection with the forecast work and a system was organized whereby the forecasts and warnings were expeditiously distributed by telephone, telegraph, and radio to the protection agencies in the forests. The value and efficiency of the forecasts were demonstrated in connection with the exceptionally numerous and serious forest fires which occurred in the Western States.

Plans also were made for establishing as soon after July 1 as possible similar fire-weather forecast projects for the forested areas of Minnesota, Michigan, and Wisconsin and for the Adirondacks and New England.

### WEATHER MAPS BY RADIO

In the latter part of the fiscal year arrangements were made by the Weather Bureau to conduct experiments for the transmission of weather maps to ships at sea by means of radio. For many years bulletins containing weather observations from land and ship stations have been broadcast twice daily for the benefit of ships in addition to general weather information, forecasts, and warnings.



Many masters enter the data on special base charts provided them for the purpose and prepare weather maps which are of great value in navigating ships. The purpose of the experiments is to transmit maps which are far more complete and accurate than can be made by ship masters. The experiments are now in progress and the project gives promise of success.

### FRUIT-FROST WORK

Because of heavy frost damage to citrus fruits in California during the winter of 1924-25, many fruit growers in that State who had not heretofore protected their orchards by heating installed heating equipment during the year, and demand on the frost specialists of the Weather Bureau for cooperation and advice was unusually heavy.

Eight specialists were assigned to duty during the frost-danger season in the citrus and deciduous fruit districts of the Western States, and there were urgent requests from fruit interests for additional service in these sections, as well as in other portions of the country. This service has become one of the most valuable conducted by the bureau.

It was not possible to meet the many requests made for extension of a specialized fruit-frost service. Accordingly, to assist fruit growers to the greatest extent possible a cooperative arrangement was made with the California State College of Agriculture whereby local representatives of that institution in a large number of counties served as meteorological observers in cooperation with the Weather Bureau district forecaster at San Francisco. Special frost warnings were thus made available to fruit growers in many parts of the State.

### WEATHER-CROP WORK

An outstanding feature of last year's work was the establishment of more than 50 additional telegraphic weather-reporting stations in the western and northwestern portions of the Cotton Belt. In recent years the area of cotton production has expanded into new territory, which was not covered by daily weather reports in these sections. This expansion was made possible through a special appropriation by Congress for this purpose, and affords daily weather information not heretofore available from important cotton-growing sections.

Weekly weather and crop bulletins are issued by the bureau showing weather conditions prevailing in different sections of the country as affecting crop growth and farm operations. The need for similar information as to weather conditions in other agricultural countries of the world has long been felt, so that the American farmer could keep in intimate touch with progress of world crops. Efforts were made during the year to obtain brief weekly weather and crop summaries from all the principal agricultural countries, and cooperative arrangements have been made so far with Canada, England, Argentina, India, and Australia, whereby reports from these are now published regularly in the Weekly Weather and Crop Bulletin. It is hoped in the near future to extend this service to still other agricultural countries.



### RIVER AND FLOOD SERVICE

However disastrous in other respects, the deficiency of precipitation during the year prevented severe floods, such as are often a source of serious loss. Such minor floods as did occur were forecast with promptness and accuracy. The most damaging of these from an agricultural point of view occurred in April in the rivers of Texas. The reported and entirely unavoidable losses to crops and livestock did not exceed \$60,000, while the reported value of property saved through the flood warnings of the Weather Bureau was more than \$200,000.

One outstanding new feature of the year was the inauguration of a system of distribution of river and weather reports, including flood warnings, by radio. This service is now in daily operation at a number of important river centers, especially Cincinnati, Ohio, where it is maintained in cooperation with the United States Engineer Corps. Through this service farmers are now able to obtain river and weather information at 10 a. m. each day, including Sundays and holidays, whereas formerly they were compelled to wait from 12 to 24 hours.

### UPPER-AIR SERVICE

In connection with the increased interest and activity in aeronautical matters, the Weather Bureau furnished considerable assistance and advice. Among the more prominent contributions of this character were: (1) The preparation of a comprehensive program of meteorological service along airways, published as part of a report on "Civil aviation" by the American Engineering Council and the Department of Commerce; (2) assistance in drafting an "Aeronautic Safety Code" for use in regulating commercial aviation; and (3) the publication of "Aeronautical Meteorology," the first of a series of texts on all phases of aeronautics, known as the "Ronald Aeronautic Library."

Notable among the events of the year was the flight of Commander Byrd to the North Pole, a flight whose successful outcome was, as stated by Commander Byrd, in considerable measure due to the advice given by a Weather Bureau representative who accompanied the expedition and was stationed at Spitzbergen. Similar acknowledgement was received from Captain Amundsen for assistance in connection with his trans-polar flight in the *Norge*.

### HOME ECONOMICS

Probably the greatest service rendered by the Bureau of Home Economics up to the present time has been the preparation of popular bulletins bringing to the housewife the practical application of scientific facts. The popularity of these bulletins is shown by their distribution. Last year more than 2,000,000 were distributed by the department and by Members of Congress. Most of these bulletins deal with the selection, care, and preparation of food.

Housewives can make a large contribution to the family income by wise selection of materials. That this fact is appreciated is indicated by a large demand for the department's bulletin, "Floors

and Floor Coverings" and also for a more recent one, "Selection of Cotton Fabrics." Bulletins on the selection of wool and silk are in preparation.

The department has for many years been interested in diet and nutrition. During the last year a summary has been prepared of all the dietary studies available up to the present time. Two conferences were called to discuss this problem, and the beginnings are being made now of a detailed dietary survey to furnish facts as to dietary habits. These facts are of importance in guiding the production and processing of food materials.

A circular entitled "Planning Your Family Expenditures" has been prepared, and a more detailed bulletin containing budgets for rural families with specific incomes is in course of preparation. This is based on material which has been collected in connection with the cost-of-living studies and actual household accounts. In cooperation with the national meat-production committee, detailed experiments have been made on roasting meat. These show that a much lower temperature than has hitherto been employed yields a more satisfactory product on roasting. There is better preservation of flavor and less loss in weight during roasting when this method is employed.

#### THE GRAIN FUTURES ADMINISTRATION

The Grain Futures Administration during the last fiscal year continued its studies relative to the volume of trading in grain futures on the various contract markets. During the 12 months ended June 30, 1926, the total volume of trading in grain for future delivery on the 11 contract markets aggregated 24,604,867,000 bushels of which 21,308,227,000 bushels, or nearly 87 per cent, represented trading on the Chicago Board of Trade, the leading grain futures market of the world. Of the total trading in all grains in all markets, 18,344,839,000 bushels, or nearly 75 per cent, represented trading in wheat futures, of which Chicago contributed 15,869,030,000 bushels or nearly 87 per cent. During the year the total volume of trading in wheat futures was only 567,000,000 bushels less than the previous year, while the total volume of trading in all grains decreased by 6,812,000,000 bushels, or nearly 22 per cent.

#### Big Transactions Covered Up

An investigation in the early part of the year revealed a number of instances in which trading operations were distributed in such a manner as to keep below the limit required for the making of reports to the Grain Futures Administration, thus making it possible to cover up large transactions which at times were important market factors. To meet this situation it was necessary to amend the rules and regulations pertaining to the enforcement of the grain futures act so as to require persons making large commitments to report their holdings direct to the grain exchange supervisor.

In the belief that the wheat growers of the Pacific Northwest would benefit through a near-by futures market, the Merchants' Exchange Clearing House of Seattle, Wash., was designated as a contract market under authority contained in the grain futures act



on January 29, 1926. Trading in wheat for future delivery on the Seattle Exchange was started May 1. While it is yet too early to determine the benefits to be derived from this market, the trading during the first few months indicates that it will be of value to the wheat farmers and will likewise afford the country dealers and millers of the Northwest the hedging facilities so long needed.

### Progress in Enforcement

During the past year progress was made in the enforcement of the grain futures act. Through cooperation with the exchanges designated as contract markets under the act, business-conduct committees were created by the important exchanges. These committees were given broad powers over the transactions in futures and so far have accomplished some excellent results in the keeping of prices more nearly in line with supply and demand. This was especially marked in the December and May wheat futures at Chicago when the business-conduct committee in cooperation with the Grain Futures Administration prevented the cornering of the wheat market.

A special investigation occasioned by extreme fluctuations which occurred in the price of wheat futures during the early part of 1925 was completed and the results thereof published as Senate Document No. 135. This investigation revealed a close correlation between the wide daily fluctuations and the transactions of a limited number of professional speculators who bought or sold May wheat to the extent of 2,000,000 bushels or more within a single trading day. Further investigation covering transactions in the 1926 May wheat future confirm the conclusions set forth in Senate Document No. 135 that these heavy trading operations may move prices far out of the normal line; and may temporarily destroy the hedging value of the futures market. Steps have already been taken to work out some plan, in so far as the authority contained in the grain futures act will permit, to eliminate from the market those hazards which are so unmistakably reflected whenever excessively large lines are held by a few individuals.

### LIVESTOCK-DESTROYING PESTS

Cooperative campaigns for the control of predatory wild animals during the year have resulted in a saving of livestock and game valued at more than \$5,000,000. Skins or scalps of 202 wolves, 35,619 coyotes, 3,204 bobcats and lynxes, 167 mountain lions, and 176 stock-killing bears were taken, and reports indicate that a much larger number was destroyed in the poisoning operations but not recovered. These campaigns were conducted in cooperation with State departments of agriculture, State livestock commissions, game commissions, agricultural extension services, and stockmen's associations. Cooperators contributed approximately \$375,000 and the department \$274,220 in support of this work. Operations for the suppression of rabies among wild animals also were successfully prosecuted as a part of the work of predatory-animal control, and were participated in by State and local health and sanitary officials.

A notable achievement during the year was the work of the predatory-animal organization of the department in California in



organizing and successfully carrying through a cooperative campaign for the suppression of foot-and-mouth diseases among deer in that State. Cooperating with the Biological Survey in the work were the Bureau of Animal Industry, the Forest Service, the State department of agriculture, and the California board of fish and game commissioners. The successful outcome of the cooperative undertaking has ended a serious menace to the livestock industry, and the experience gained in the campaign will be invaluable in case of future similar outbreaks.

### **Controlling Destructive Rodents**

Special research work in the use of thallium compounds, crude calcium cyanide, and red squill for the control of destructive rodents has developed very important results. Cooperative poisoning operations to reduce agricultural losses from rodents covered more than 15,000,000 acres and made an estimated saving in crops and forage grasses of more than \$6,800,000. The department contributed \$166,680 and expert leadership, while cooperators provided \$614,560 and a vast amount of voluntary labor in distributing the poisoned baits on Federal, State, and privately owned lands. Arrangements made for the purchase of supplies and poisons in wholesale quantities increased the effectiveness of the control measures and resulted in a marked reduction in costs to cooperators. This service is actively supported by farmers and stockmen because of its very evident and direct value to them. It is closely coordinated with the extension work of the department, with State agricultural extension services, State departments of agriculture, county commissioners, and agricultural, horticultural, and livestock organizations. When the work was first undertaken the annual loss caused by rodents in crops and forage over hundreds of millions of acres was estimated at approximately \$300,000,000. The work of suppressing these pests has now advanced to the stage where the permanent improvement of conditions represents a saving of a substantial part of the former losses, in addition to benefits resulting from the operations for the year.

It has been found that in great areas on the national forests rodents are so destructive to young trees that without their control successful reforestation becomes almost, if not quite, impossible. For several years naturalists of the department have been studying these problems, and good progress has been made in the work during the present year. Studies of the life history of the porcupine, one of the most destructive of these animal pests, have been nearly completed, and the information gained is of direct practical value in the cooperative rodent-control operations.

### **Attempts to Increase Quail**

Important progress was made in the investigation of the causes of depletion of both native and introduced quail in the Southeastern States. The studies are being made in cooperation with resident sportsmen to determine the best methods of keeping coverts permanently stocked with this desirable game species. Particular attention is given to the causes of failures to rear young birds, including diseases, requisite food supply, and the control of such natural enemies as tend to keep the numbers of this economically important

species reduced. During the year the department issued permits for importations of 37,134 quail from northeastern Mexico, mostly for liberation in Southern States. Three of the States importing the largest numbers—Kansas, Oklahoma, and Texas—furnished 20 years ago or more most of the stock for other regions, and during this year 1,000 quail were reintroduced at a point in Oklahoma from which some of the largest shipments were formerly made.

### Surveys of Wild Life

In continuation of its special and general investigations of definite wild-life areas, the department has sent biologists to parts of Alaska and Mexico to observe conditions affecting the welfare of migratory birds. In Alaska, studies were made early in the year of the fauna in the eastern Aleutian Islands and adjacent parts of the Alaska Peninsula, the home of a variety of important species of mammals and the breeding place of many game and other birds. Later in the year an expedition was sent to northern Alaska to band migratory wild fowl on their breeding grounds, to ascertain definitely their lines of flight, through the later recovery of the bands in other parts of the continent, as an aid to the administration of the migratory-bird treaty act regulations.

A biologist sent to Mexico for the purpose studied conditions on the principal wintering grounds of migratory waterfowl to obtain information necessary for consideration in formulating a possible arrangement with Mexico for the protection of migratory birds, similar in intent to the treaty that protects birds migrating between the United States and Canada. It was ascertained that the wild fowl, especially ducks, that go south from the United States to spend the colder months in numerous lakes and marshes in Mexico, are in need of better protection, as their numbers are decreasing through slaughter for market. The sale of migratory game birds is prohibited in both the United States and Canada under the terms of the migratory-bird treaty with Great Britain.

### Surplus Game on Reservations

An outstanding achievement in connection with the administration of game and bird reservations by the Bureau of Biological Survey during the year was the disposal of 389 surplus elk and their shipment by special train from the National Bison Range in Montana to an elk-breeding association in Massachusetts. The removal of most of the elk on this range had become imperative in order to conserve forage urgently needed for buffalo, mountain sheep, and other game, including a smaller number of elk, overgrazing having reached such a point as to threaten serious injury to the range and a permanent reduction in its carrying capacity. No precedent is known for the handling of live game animals on so large a scale, and these were only a part of the elk the department is under contract to furnish the purchaser, several hundred remaining to be delivered. The receipts from the sale of surplus stocks of game from the four fenced reservations administered by the Biological Survey netted the United States Treasury \$26,530.74.

### CONSERVING ALASKA'S GAME AND FUR

That the new Alaska game law, after the first year of its existence, has had the approval and support of the public is evidenced by the treatment of violators in Territorial courts. In 55 cases brought for prosecution, 43 defendants pleaded guilty, 10 were convicted, and 2 were acquitted; and the penalties imposed included both heavy fines and imprisonment. The new law is administered by a resident commission of five members, one from each of the four judicial divisions of the Territory and the fifth the chief resident representative of the Bureau of Biological Survey. Through representation on the Alaska Game Commission the bureau renders great assistance to the commission in planning and carrying out its program of wild-life conservation.

In the short period the law has been in operation excellent results have been accomplished in the conservation of game and fur animals, one of the most valuable resources of the Territory. Skins of land fur animals exported from Alaska during the year were valued at \$2,500,000, an increase of \$500,000 over shipments of the previous year. With proper enforcement of the new law, the stocks of wild life can be materially built up and game and fur production increased. As game is the only fresh meat to be had in large portions of Alaska, and as big-game hunters are each year visiting the Territory in greater numbers, every effort will be made to maintain the big game to the capacity of the ranges.

### FUR FARMING

Fur farming is an important industry on suitable islands in southern Alaska, and is also well established in the United States and Canada. There are about 2,500 fur farmers in the United States and Alaska and about 1,500 in Canada, the majority of whom are raising silver and blue foxes. The total investment in the industry in the United States and Alaska is about \$30,000,000 and in Canada about \$11,000,000. Fur farming is also being undertaken in European countries and in Japan, where it is having a quiet but steady development.

The department maintains an experimental fur farm at Saratoga Springs, N. Y., where studies of the production of fur animals in captivity include economical methods of operation and the prevention and cure of parasitic and other diseases. Publications of the department on the propagation of fur animals are in continuous demand by persons who contemplate taking up the work and by those already engaged in it.

### INSECTICIDE AND FUNGICIDE INVESTIGATIONS

An important investigation that has been brought to a conclusion during the last year has been an investigation of the effectiveness against the San Jose scale of dry substitutes for lime sulphur solution. This work has demonstrated that the commercial products on the market, recommended as substitutes for lime sulphur solution, viz, calcium sulphur ("dry lime sulphur"), sodium sulphur, and barium sulphur preparations, when used at strengths recommended



by the manufacturers, in fact in strengths much greater than ordinarily recommended, do not furnish a satisfactory control of the San Jose scale. These results, which have been published and widely circulated, will be of great value in all fruit-growing sections where the San Jose scale is prevalent, and will also enable the department to bring action against the manufacturers of these products under the provisions of the insecticide act, unless the faulty claims are corrected.

Two investigations that will be of great value to manufacturers, as well as to consumers of the products involved, are the determination of the rate of loss of nicotine from nicotine dusts after packing, and the rate of deterioration of bleaching powder during storage. Both of these products, as ordinarily packed for consumption, lose their strength more or less rapidly with lapse of time, and it is impossible for the consumer to determine before use whether or not the product will be effective for the purpose for which it is used. With the information now available, manufacturers will be able to so pack and label these articles that the consumer may buy and use them with more assurance that the results desired will be obtained.

#### **Worthless Lice-Control Preparations**

A few years ago there began to appear on the market products to be administered to chickens in the food or drinking water to control lice, mites, and other external parasites. The products were delivered to purchasers by mail for the most part, and customers were obtained by inserting advertisements in farm papers and daily and weekly newspapers. Information obtained by the department indicated that such a method of freeing chickens of insects was of very doubtful efficacy and prompt action was taken to obtain official samples of the various products for analysis and test in connection with the enforcement of the insecticide act. Most of the preparations were some form of sulphur.

An easy way to rid chickens of insect pests evidently had its appeal to thousands of people who desired some easy way to get rid of a troublesome job. Tests were completed and the products found to be ineffective. Seizure of shipments, prosecution of manufacturers, and publicity by sending broadcast over the country copies of Service and Regulatory Announcements No. 48 were the means adopted to curtail the distribution of these products and inform the public concerning them. No doubt the board's campaign against the products has been very materially aided by the editors of farm papers, which formerly carried the advertisements, now refusing to permit their papers to carry advertisements of a remedy that they are convinced is without merit.

#### **DISINFECTANTS**

The use of disinfectants is becoming more widespread in the home, on the farm, in industrial plants and institutions, and in all places of public assemblage. Considerable numbers of the disinfectants examined under the insecticide act have been found without, or practically without, virtue or merit as germ destroyers, although the labels, circulars, and newspaper advertisements created the impres-

sion that they were unexcelled. The regulation of these materials has been one of the most difficult problems connected with the enforcement of the insecticide act. The danger that lurks in the use of inefficient or partially efficient disinfectants is evident, especially where a contagious disease is to be dealt with. The sale of a material as a disinfectant which in practice does not disinfect, is something more than a fraud on the public; it is a menace to public health. The activity of the campaign made against disinfectants and the need for regulation is shown by the fact that 260 of the 1,050 notices of court judgments issued to date were based on samples of disinfectants. Without resort to prosecution, the correction of many labels was secured through correspondence with manufacturers. A great improvement has been brought about in the labeling of disinfectants in general. The campaign against adulterated and misbranded disinfectants of various kinds has been continued throughout the year, special attention having been given to disinfectants which are recommended at too great dilution to be effective.

### CALCIUM ARSENATE FOR BOLL-WEEVIL CONTROL

The campaign inaugurated in 1919 and involving the inspection of the calcium arsenate shipped to the South for use in controlling the cotton boll-weevil, was continued during the year. It was found that the composition of this article was growing more constant and satisfactory from the viewpoint of control and lack of burning qualities. The tonnage of calcium arsenate sold on the market each year is undoubtedly far beyond the tonnage of any other single insecticide or fungicide. Less than 10 years ago only a few thousand pounds of calcium arsenate were on the market. During the year nearly 20,000,000 pounds of the product was produced, most of which was used to protect cotton from the boll-weevil. The discovery a few years ago of the effectiveness of calcium arsenate against the cotton boll weevil was the signal for its production by many manufacturers who were inexperienced in making the product. Through the enforcement of the insecticide act the department was able to keep off the market many tons of this material which was improperly made. The application of this low-grade material would have resulted in direct damage to the cotton crop and indirectly would have been a deterring influence on the willingness of planters to follow the department's advice in the use of the material.

### THE FOREST PROBLEM

One of the major economic problems of agriculture is the forest problem. Future rural prosperity and agricultural stability are closely linked with successful timber growing as a permanent form of land use. One-fourth of the land area of the United States is forest land and in the main will continue to be forest land. The cutting out of forests and the withdrawal of forest-supported industries make for local and regional economic retrogression. They decrease population, curtail the farmer's local market, deprive him of opportunities to work in the woods in off times, lessen taxable values, and increase his own taxes, and give him fewer and poorer schools, churches, roads, stores, neighbors. Contrariwise, fully sustained



yields from forest land through the intelligent practice of timber growing aid agriculture and both stabilize and promote rural prosperity. Social as well as economic welfare is involved.

Merely from the standpoint of farm crops forest products rank high. As a money crop, at the time of the last census forest products gave the farmer a return of nearly \$220,000,000. This was a greater total than the farmers obtained from all sugar crops and was nearly half the value of the tobacco crop. Forest products consumed on the farm in such forms as fuel, fencing, and sawed and round construction material had a further value estimated at more than \$175,000,000. Yet farm woodlands are seldom skillfully handled; they should yield much more. How to make full use of the growing power of his present forest land, and of other land on the farm really best adapted to forest use, is an urgent question for the individual farmer. Until he has the answer he is at a disadvantage. But as a problem of rural economics and rural social welfare the forest problem is of much broader scope.

#### Lean Acres Add to Surpluses

Agricultural instability is increased if land is cultivated on which farming does not pay. Under the urge of land hunger and the momentum of agricultural expansion across the continent, the plow has sometimes broken ground where the soil was too poor or rocky, the slopes too steep, or the climate too dry or cold to afford the tiller a fair living. The war, with its appeal to the farmer to increase production as a patriotic obligation, brought under crops still more land of relatively low productivity. Agricultural surpluses are swelled by the output of these lean acres.

Much has been heard of the "abandoned farm" in New England. There and in some other Eastern States the tide of cultivation began to ebb long ago. Between 1880 and 1920 the improved farm land in New England decreased more than 7,000,000 acres—a reduction of over 53 per cent. In the Middle Atlantic States it decreased nearly 6,700,000 acres. For the country as a whole, however, it increased each decade. Between 1910 and 1920 the increase was not quite 25,000,000 acres, or 5 per cent. What the plow surrendered in the East between 1880 and 1920 was more than made up by what it conquered elsewhere.

Yet the rate of increase, which was fairly uniform down to 1910, slackened greatly thereafter. With the approach to exhaustion of new lands to settle not only the quantity but also the quality of the acreage brought under cultivation fell off; and farm abandonment is no longer limited to the older parts of the country. By the process of trial and error the line is gradually being drawn between the lands which can and the lands which can not be successfully cultivated under present conditions. It is important to promote rather than delay the adjustment, as one of the means of promoting agricultural stability.

#### Grazing Homestead Act

The pressure for more land to homestead in the decade 1910-1920 was very strong. One of the consequences of this was the grazing homestead act. Under that act relatively little land was taken up on



which settlement has been maintained. The grazing homestead act is now generally recognized as a mistake. The same demand for opening land to settlement led to the listing for entry of a considerable total of acres within the national forests, which, it is now apparent, were erroneously classified as agricultural, since they either have not been taken up at all or have been abandoned after settlement or have become the means of establishing families where a fair living can not be made. We are beginning to see that a healthy and prosperous rural life must be based on sound use of land, that public policies which fly in the face of economic laws do not promote permanent welfare, and that to convert forest land and pasture land into submarginal agricultural land has broader consequences than those which fall on the individual farmer and his family, or even on the local community.

To the individual they mean an uphill struggle, poor living, and often a losing fight; to the community sooner or later a net loss; but to the country at large they mean an undue depression of the prices of the crops produced and a material waste of productive power. Abandonment of cultivation makes the backward swing of the pendulum. It constitutes a necessary though painful correction of past mistakes. It points also to the need of avoiding so far as possible future mistakes of the same kind. A sound national policy of forestry aimed to bring about timber growing on the land for which timber will be the best-paying crop is a means to this end.

The development of such a policy must be accomplished by the Federal Government and the States jointly. The fundamental task is to assist and hasten the adjustment of land use to the productive possibilities of the land itself and to public needs for what can be grown. Many of the old fields and pastures of New England whose cultivation ceased from a quarter to half a century ago have been reclothed by nature with at least a partial growth and not infrequently with a valuable growth of forest trees. In some instances the owners of the land had the discernment to hasten this process by forest planting or to apply other measures of timber culture.

#### Large Earnings of Timberland

To a remarkable degree the outcome has been favorable. Enough examples of the returns obtainable from timber growing in every part of the East are at hand to leave no doubt that it is the best form of use for a great deal of land formerly regarded as agricultural. The earning power of such land under timber is often astonishingly large, and going land prices are often materially below what that earning power would justify.

In short, there is no need to wait while economic forces work their slow and painful adjustment. Continuous right use of the land can get much more out of it than mistaken use which must subsequently be rectified by taking the back track. Nor is it necessary for the farmer, part of whose land will earn him most by producing timber, to wait while nature gradually restores a haphazard forest growth on abandoned fields. There is a much better remedy for misplaced agriculture, with its waste of human effort, than abandonment of use—the remedy of guidance and assistance to right use.

In regions where large areas of logged-off timberlands are awaiting development, or where tax-reverted lands are common, the land, tax, agricultural, and forest policies of the individual States should be so integrated that they will all work together to restore to forest use as quickly as possible the land that ought to be so used. In particular, State policies should aim to deter settlers from establishing on this land farms that in all probability are foredoomed to failure. Economic surveys and land classification such as Michigan has inaugurated are a means to this end. Colonization schemes which seek to dispose of land through high-power salesmanship, regardless of the consequences to those who buy, should be controlled. But the most important task is the work of research and education necessary in order that the farmer may know where and how to grow tree crops.

### Forest-Minded Farmers

The most economic apportionment of our farms into the three classes of plow land, cleared pasture, and woodland requires that our rural population be not only agriculturally-minded but forest-minded. Timber culture must become interwoven into the traditions of farm practice. How to grow trees well is a question no easier to answer than how to grow potatoes or apples or sugar beets well. Crude and elementary methods of handling the forest will not produce first-class yields. Carefully organized research and demonstration must be carried on to develop an adequate scientific basis for good silviculture, and as fast as knowledge becomes available it must be passed along to the farmer. For the latter purpose, fortunately, many agencies are at hand which can and must be efficiently utilized—the agricultural colleges, high schools, the elementary rural schools, agricultural extension, the agricultural press, and other like means of affecting thought and practice. This twofold task of scientific research and rural education in forestry is in the main a public function, which the Federal Government and the States must share, as they are sharing in essentially the same task for the advancement of agriculture generally.

Amongst the obstacles to farm forestry one of large immediate importance is the lack of an adequate source of supply of forest planting stock. To reforest farm lands for which trees constitute the best crop and on which artificial reforestation should be undertaken an enormous quantity of cheap nursery-grown stock will be needed. Until private nurseries and methods of commercial nursery practice have been developed to meet this need the only way apparent to speed up the restoration to productiveness of the many millions of acres of waste farm land is through public production and supply of small trees. The Clarke-McNary law opened a way for the Federal Government and the States to join hands in building up forest nurseries, and already encouraging and significant results are in evidence. Thirty-three States have inaugurated cooperation with the Federal Government under the provisions of this section of the law; the nurseries now in existence have a present capacity of 52,000,000 trees and an output in 1927 of approximately 80,000,000 trees is expected; and the demand for stock is rising at a gratifying rate.



**PROGRESS UNDER CLARKE-McNARY LAW**

The Clarke-McNary law authorizes and directs the Secretary of Agriculture to recommend for each forest region of the United States adequate systems of forest-fire prevention and suppression. The law prescribed that this should be done in cooperation with appropriate officials of the various States or other suitable agencies. It also authorized and directed the Secretary to cooperate with the individual States in the protection of timbered and forest-producing lands from fire if he finds that the system and practices of forest-fire prevention and suppression provided by the State substantially promote the protection of forest and water resources and the continuous production of timber on lands chiefly suitable therefor.

This law clearly contemplates a program based neither on the theory that the remedy for whatever ills exist should be sought through the extension of Federal power into a new field or jurisdiction nor on the theory that the remedy must be left solely to the States to discover and work out, as falling in a sphere beyond the proper concern of the Federal Government. It recognizes that the problem is a national as well as a State problem, but it has in view neither Federal encroachment nor the affirmation of a "non possumus" in the name of "States' rights." Instead it aims at the assumption and accomplishment of a joint task, under a method of common counsels and agreement.

Excellent progress is being made under this law toward nationwide forest-fire control effected through a combination of voluntary action by lumbermen and timberland owners, State legislation to abate fire hazards, State protective systems, and Federal participation in the maintenance of these systems and in the development of the general policy. An outstanding example of State legislation is furnished by Idaho in the form of a law requiring lumbermen to dispose of their slash and making it obligatory upon owners of timberlands to provide satisfactory protection both for standing timber and for cut-over lands. The whole question of the extent to which woods practices require modification in the interest of protection as an essential for continuous timber production is being studied regionally by the Forest Service and the State forestry departments in cooperation.

**Better Cooperation in Prospect**

This question is by no means simple. It will have to be carefully worked out, a step at a time, and with full opportunity for the cooperation of the lumber industry in analyzing the technical and practical problems involved and in devising the right remedies. This cooperation is on the whole in prospect to an unexpected degree, and with indication of a growing sense of responsibility to the public on the part of the industry, for the voluntary elimination of practices inconsistent with permanence of the forest resource to the extent that economic conditions make feasible.

The extension and improvement of organized protection of forest lands against fire under the stimulus of the Clarke-McNary law and somewhat enlarged Federal appropriations for this form of cooperation with the States has been notable. This is particularly con-



spicuous in the South. As the contribution of the Federal Government more nearly approaches the amount contemplated by the act, its influence and benefits will be proportionately increased. In the States which are doing most, the present financial share of the Federal Government in protecting the forest resources, basic for the supply of national needs, is exceedingly meager.

### THE NATIONAL FORESTS

The conduct of the Federal enterprise in forest management is on the whole proceeding satisfactorily along sound lines. It has the approval of the public, is directed with vision and intelligence, and is characterized by a high degree of business competence. The cut of national forest timber is on the whole steadily rising, though with minor fluctuations due to variations in market demand corresponding with the ups and downs of general business activity; last year's cut surpassed that of any previous year both in volume and in money value, aggregating the equivalent of 1,192,000,000 board-feet, with receipts from timber totaling \$3,368,685.

The timberland on the national forests productive of lumber and other high-grade forest products is around 85,000,000 acres; its eventual annual yield is the equivalent of probably 7,000,000,000 board-feet, log scale; and while its current yield is about 2 per cent of the country's total cut of these products, its estimated eventual yield is around 14 per cent. To obtain this, however, some 2,000,000 acres of burned-over forest land must be restored to productivity through planting unless the slow and uncertain process of natural reforestation is to be looked to—a process at best of many decades, during which the cost of administration and protection must run as an accumulating charge. This is neither economy nor foresight. The timber which the land might be growing will be urgently needed by the public long before it can be produced in any case.

#### Permanent Production is Object

As market requirements permit, national forest timber sales are converting areas occupied by mature stands from mere storehouses of wood into growing forests; and the first consideration in all plans for selling timber is not immediate revenue but maximum permanent production. The further this process of rejuvenation is carried, the greater the investment in the public enterprise of growing timber on these lands. Fire control is essential to keep this investment from being wiped out. It is also, along with forest planting where planting is necessary, the means of establishing young growth on all the land needing it—in other words, is in itself largely an investment and not purely an expenditure to safeguard the present merchantable timber and smaller trees. Future public timber requirements make it obligatory to build up the national forests as producing properties with the least possible delay. The program essential to accomplish this now lags. This holds true both with regard to the provision for forest planting and with regard to the provision for fire control.

The expenditures for forest nurseries and tree planting last year were, in round numbers, \$170,000, out of a total for all purposes in

connection with national-forest administration of over \$20,000,000 or exclusive of roads and trails of over \$7,000,000. The area planted was 11,552 acres. The area in need of planting is approximately 2,000,000 acres. Through the acquisition of new lands by purchase and exchange and through the ravages of fire in bad seasons like last summer, when with the present provision for fire control considerable losses are certain, the area in need of planting is becoming not less but greater. Were there to be no increase in the present area needing artificial reforestation, about 165 years would be necessary at the present rate to complete the task. Obviously no such delay could be tolerated. The question is merely how long the exigencies of the general financial program of the Government will continue to preclude entering on the task in earnest. In view of its importance I believe that some enlargement of the work at the earliest possible date is imperative.

### FOREST-FIRE PREVENTION

The summer of 1926 made clear that the time has come for a radical change in the method of making funds available for protecting the national forests against fire. The need is not for larger expenditures but for greater flexibility in the use of money. Altogether too large a part of the total now goes to fighting large fires which with better preparedness need never have spread over much ground or which need never have originated at all. It is emphatically a case of saving at the spigot and wasting at the bung hole. In the last 18 years fire fighting on the national forests has cost over \$15,000,000. Of this about \$9,500,000 was spent on fire fighting in five bad years. There is practically no limit to the expenditures which the Forest Service is expected to make if necessary in order to stop large fires. Thousands of men hastily recruited from the neighboring country, lumber camps, and other industrial enterprises interested in getting the fires out, and the sources of labor supply in the cities may then be thrown upon the fire lines; tools, bedding, subsistence, transportation, pumps, and equipment of any kind needed and quickly obtainable can be procured; and the fight can be waged week after week in the heart of the wilderness.

A plan that is therefore deemed eminently more desirable than the present one of bolting the barn door after the horse has been stolen is to provide adequate locks and safeguards in the beginning. In other words, we should prevent rather than have to put out at great expense the large destructive fires that have devastated such vast areas of valuable forests.

### VIOLATIONS OF REGULATORY LAWS

The solicitor for the department reported to the Attorney General during the year 2,509 violations of the various regulatory laws which have been intrusted by Congress to the department for administration. Of these, 861 involved criminal prosecution and 1,648 involved civil actions. Fines, penalties, and recoveries, secured in litigated and nonlitigated cases amounted to \$11,911.18; decrees of condemnation and forfeiture were entered in 912 seizure cases tried under the food and drugs and the insecticide acts; and 900 notices

of judgments were prepared for publication, pursuant to the requirement of these laws.

Applications for letters patent, 31 in number, on inventions of employees of the department were prepared and filed in the Patent Office. Twenty-seven applications were allowed and four were disallowed. The inventions patented covered a wide field in the patent art. Many of them were of unusual merit, and probably will be extensively used.

Titles to lands in excess of 200,000 acres were examined, resulting in the acquisition by the Government of 180,711 acres under the Weeks forestry law. Titles to considerable acreage were also examined for acquisition by the United States under the Upper Mississippi River wild life and fish refuge act. In the latter instance, the abstracts of title have been transmitted to the Attorney General for his consideration and approval.

### THE LIBRARY

The library of the department now contains about 200,000 books, pamphlets, and bound periodicals, 14,969 of which were added during the last year. More than half of these and about two-thirds of the 3,356 periodicals currently received were obtained as gifts, or by exchange for department publications. They come from nearly every civilized country of the world and in nearly every language. A mimeographed series of "bibliographical contributions" issued from time to time by the library has proved useful. Numbers 10 and 11 of this series were issued during the year. Number 10 is entitled "Refrigeration and cold storage; a selected list of references covering the years 1915-1924 and the early part of 1925." Number 11 is a "List of manuscript bibliographies and indexes in the U. S. Department of Agriculture, including serial mimeographed lists of current literature." The library of the Bureau of Agricultural Economics issued during the year 10 additions to its mimeographed series of "Agricultural Economics Bibliographies." One of these is entitled "Alabama: An index to State official sources of agricultural statistics," and is the first of a series of indexes to State agricultural statistics which has been undertaken by the Bureau of Agricultural Economics library in cooperation with the State agricultural college libraries.

### DEPARTMENT PUBLICATIONS

A total of 30,629,006 copies of the department's various publications were issued during the year. This includes 3,942,200 copies of periodicals and 26,696,806 copies of bulletins and circulars. About 60 per cent of the publications were new while the rest were reprinted to meet the demand for information contained in the older publications.

Greater printing costs made it necessary to restrict distribution of publications and to economize in printing wherever possible. The policy of sending out announcement cards calling attention to new titles was continued, with the result that thousands of bulletins were saved and made available for those to whom they would be



of most value. The same plan was extended to include articles reprinted from the Journal of Agricultural Research.

The newly established radio service aided materially in the distribution of agricultural information, carrying in condensed popular form much of that contained in bulletins and circulars. Thousands of those who listened to the radio talks wrote to the department requesting further information on the subjects discussed.

There has been an increasing demand for information in the nature of progress reports of the various investigations being carried on by the department. To meet this, preliminary reports have been issued in mimeographed or multigraphed form. Such reports serve a very useful purpose in that the information is made available before it is possible to issue a printed bulletin based upon the completed investigation and final recommendations.

### PERSONNEL SITUATION

On June 30, 1926, the department had on its rolls 20,742 employees. This is an increase of 155 employees over the total force on the rolls June 30, 1925, but during the year we have effected a decrease of 103 employees in Washington, making a net increase of 258 in the field service of the department. The increase is due to the expansion of certain lines of work for which Congress provided increased appropriations and for the execution of new duties placed upon the department by legislation. The turnover in the personnel during the fiscal year 1926 was 11.41 per cent which was approximately the same as the percentage during the preceding year. Further adjustments made in accordance with the salary classification act have had a tendency to stabilize the personnel situation, and with the benefits under the new retirement act, still further improvement may be expected.

### HOUSING SITUATION

Better housing conditions for the Department of Agriculture in Washington apparently are assured by the passage of the public buildings act approved May 25, 1926. From information available at this time the department is among the first of the executive branches for which new buildings are to be provided under this act. The central building connecting the east and west wings constructed some years ago presumably will be the first unit to be constructed for the department, conforming architecturally with the wings and in general with the original plan, modified so as to provide additional floor space. The construction of this building will result primarily in a great improvement in the appearance of the Mall and the building as a whole will be representative of the place of agriculture in the Nation. While, however, the construction of the central building will permit the further consolidation of the general administrative branches of the department, it will not provide much, if any, additional floor space for the department, since the present administration building and the several smaller buildings now occupied on the Mall presumably will be razed when the east and west wings are connected. The real relief from the present unsatisfactory housing situation, therefore, will come with the completion of additional buildings for the department for which pro-

vision is made in the building program. When these additional buildings are constructed it will be possible to bring together the numerous bureaus and offices at present scattered among some 40 buildings, many of which are located at points remote from the general departmental group. This will make for greater efficiency and economy in operation and will increase generally the effectiveness of the service which the public has come to expect from the Department of Agriculture. The actual accomplishment of the entire building program, therefore, will be a matter of extreme gratification not only to all members of the department but to the agricultural industry at large.

#### GENERAL ADMINISTRATION

During the year the members of the department have continued to cooperate whole-heartedly in the observance of the permanent business policy of the organization, heretofore announced, which is in all matters, whether large or small, to insure value received to the taxpayers for every dollar spent for Federal activities. Typical instances of economies effected, better business arrangements established, etc., during the year have been reported to the Budget Bureau and will be found in the annual report of the director of that bureau for 1926, pages 107 to 124.

In my last report I called attention to the consolidation of the units engaged in work relating to the general personnel and business administration of the department into one office under the supervision of a director of personnel and business administration. The new arrangement has fully justified its establishment. The reorganized plan of operation has concentrated authority and responsibility and provided better and more economical administration. New opportunities for improvement in the methods of conducting Government business and for effecting economies are constantly being encountered and taken advantage of, and in addition a gratifying reduction in personnel and in expenditures for this class of work has been effected during the year in which the plan has been in effect. The United States Bureau of Efficiency also has continued to cooperate with the department during the year and has rendered valuable assistance of the most practical sort through investigations and recommendations concerning personnel and business procedure.

W. M. JARDINE,  
*Secretary of Agriculture.*

## FINANCIAL STATEMENT

### Expenditures, Department of Agriculture, Fiscal Year 1926

Funds expended and obligated for work under the supervision of the Department of Agriculture for the fiscal year which ended June 30, 1926, including road building, totaled \$157,485,660.84, classified as follows:

#### (1) Regular work

For regular work of department (activities for which the department is directly and independently responsible), as follows:

Office of the Secretary-----	\$948,599.01
Division of Accounts and Disbursements-----	75,247.71
Office of Information-----	1,084,160.87
Office of Experiment Stations-----	330,872.36
Extension Service-----	1,538,817.66
Weather Bureau-----	2,431,090.47
Bureau of Animal Industry-----	12,625,199.81
Bureau of Dairying-----	509,143.83
Bureau of Plant Industry-----	3,802,405.22
Forest Service-----	8,890,292.23
Bureau of Chemistry-----	1,456,862.64
Bureau of Soils-----	393,876.60
Fixed Nitrogen Research Laboratory-----	240,601.49
Bureau of Entomology-----	2,482,768.65
Bureau of Biological Survey-----	968,021.44
Library-----	68,105.18
Bureau of Public Roads-----	468,624.03
Bureau of Agricultural Economics-----	4,747,719.08
Bureau of Home Economics-----	115,022.49
Insecticide and Fungicide Board-----	187,115.81
Federal Horticultural Board-----	687,832.92
Packers and Stockyards Administration-----	401,415.05
Grain Futures Administration-----	100,033.10
Farmers' seed grain loans-----	22,560.39
Total expenditures for regular work-----	44,576,388.04

#### (2) Other than regular work

For work administered by department, supported by Federal funds provided as direct aid to States for special forestry and wild-life conservation work and similar objects, as follows:

<b>(a) Special conservation work:</b>		
Cooperation with States in fire protection of forested watersheds of navigable streams-----	\$652,322.88	
Cooperation with States in farm forestry extension and distribution of forest planting stock-----	81,242.04	
Acquisition of lands for protection of forested watersheds of navigable streams-----	1,025,495.17	
Acquisition of lands for upper Mississippi River wild life and fish refuge-----	30,115.69	
		\$1,789,175.78
<b>(b) Colleges and stations:</b>		
Payments to State agricultural experiment stations for research work under Hatch, Adams, and Purnell Acts-----	2,400,000.00	
Payments to State agricultural colleges for extension work in agriculture and home economics under Smith-Lever Act-----	5,880,000.00	
		8,280,000.00

<sup>1</sup> Including \$3,511,464.16 paid to livestock owners as indemnities for animals destroyed in connection with tuberculosis and foot-and-mouth disease eradication, and \$5,033,396.63 for meat-inspection service.



(c) **Road construction under Federal-aid roads act of July 11, 1916, as amended and supplemented:**

Payments to State highway departments for cooperative construction of Federal-aid highways-----

\$89,362,110.64

Forest roads and trails-----

9,353,252.23

\$98,715,362.87

(d) **Forest Service receipt funds:**

Payments to States for benefit of local roads and schools (national-forest receipts)-----

1,271,275.69

Roads and trails for States (national-forest receipts)-----

677,935.88

Cooperative work, consisting principally of forest road and trail construction, also improvements, fire prevention and suppression, disposal of brush in timber-sale operations, and investigational work (paid from private contributions)-----

2,042,034.20

Refunds to users of national-forest resources of moneys deposited by them in excess of amounts required to secure purchase price of timber, use of lands, etc-----

133,488.38

4,124,734.15

Total expenditures for work administered by department (other than regular work)-----

\$112,909,272.80

Total expenditures for regular activities of and work administered by department-----

157,485,660.84

### **Expenditures for Regular Work**

#### *(1) Net cost of work*

As indicated by the foregoing table, total expenditures during the fiscal year 1926 for the research, extension, service, and regulatory functions of the department, or what may be designated as its "regular work" (as distinguished from work supported by Federal funds administered by the Department of Agriculture but made available for direct use by the States or for special conservation purposes), amounted to \$44,576,388.04. Partially offsetting this figure, earnings in connection with these activities during the year, amounting to \$5,486,616.88, deposited in the Treasury of the United States to the credit of "miscellaneous receipts," and \$137,600.91 received as fees for classifying cotton and credited to the revolving fund for that purpose, make the actual net cost to the Federal Government of the department's regular work \$38,952,170.25.

#### *(2) Distribution by types of activity*

The total expenditure of \$44,500,000 for regular work was distributed by types of activity approximately as follows:

	Amount	Per cent
(a) <b>Research</b> (including investigations and experiments in animal and plant production, breeding, and improvement, in methods of controlling diseases, insects, and other animal and plant pests, for soil and fertilizer studies, for the investigation of farm management, marketing, and crop utilization problems, and other scientific studies and investigations of the fundamental problems of agriculture, horticulture, forestry, etc., by means of laboratory and field experiments)-----	\$10,300,000	23.1
(b) <b>Extension work</b> (demonstration and educational work by means of county agricultural and home demonstration agents, through exhibits, motion pictures, or otherwise, with a view to the dissemination of the information developed by the experiments and discoveries of the department and the various States)-----	2,300,000	5.2
(c) <b>Eradication or control</b> (direct control or eradication of plant and animal diseases, insects, and other pests, through organized campaigns, either independently or in cooperation with State agencies)-----	9,300,000	20.9
(d) <b>Service work</b> (including such activities as the administration and protection of the national forests, the weather service, crop and livestock estimating, market news services, shipping-point and terminal-market inspection service on perishable farm products, and other work of like character for the benefit of the public, not primarily involving research or the enforcement of special laws of a regulatory nature)-----	12,900,000	29.0
(e) <b>Regulatory work</b> (administration of regulatory laws, such as the food and drugs act, the meat inspection law, the migratory-bird treaty act, the grain standards act, warehouse act, etc.)-----	9,700,000	21.8
Total-----	44,500,000	100.0

**Income from Department's Activities, Fiscal Year 1926**

Incident to the department's work during the fiscal year 1926 direct receipts aggregating \$8,829,953.15 were covered into the Treasury and fines were imposed and judgments recovered by the courts amounting to \$111,911.18 in connection with the enforcement by the department of the regulatory laws which devolve upon it for administration and execution, as follows:

*(1) Receipts*

Deposited to credit of miscellaneous receipts fund:

Regular work—	
From business on the national forests.....	\$4,641,415.72
From other sources.....	845,201.16
	<u>\$5,486,616.88</u>

Work administered (other than regular work)—

10 per cent of net receipts from business on the national forests appropriated as a special fund for forest road and trail construction in 1927.....	514,205.38
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Proceeds from sale of surplus war materials transferred to States for road-construction work.....	114,817.35
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Contributions from private cooperators appropriated as a special fund for road and trail construction, fire protection and suppression, brush disposal, and investigative work on national-forest and privately owned lands.....	1,925,149.98
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	<u>2,554,172.71</u>
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Total deposited to credit of miscellaneous receipts fund.....	<u>\$8,040,789.59</u>
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Deposited to credit of applicable funds of department:

Fees collected for classifying cotton deposited to credit of revolving fund for conducting this work.....	\$137,600.91
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Reimbursement to various appropriations of department for expenditures made therefrom.....	651,562.65
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Total deposited to credit of funds of department.....	<u>789,163.56</u>
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Total receipts.....	<u>8,829,953.15</u>
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*(2) Fines*

Fines imposed and judgments recovered by the courts in connection with violations of statutes entrusted to Department of Agriculture for enforcement.....

	<u>111,911.18</u>
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Total direct income from activities of Department of Agriculture.....	<u>8,941,864.33</u>
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JAN 18 1927

EXPERIMENT STATION FILE

## REPORT OF THE ACTING CHIEF OF THE BUREAU OF AGRICULTURAL ECONOMICS

UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF AGRICULTURAL ECONOMICS,  
*Washington, D. C., August 31, 1926.*

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Agricultural Economics for the fiscal year ended June 30, 1926.

Respectfully,

LLOYD S. TENNY,  
*Acting Chief of Bureau.*

HON. W. M. JARDINE,  
*Secretary of Agriculture.*

The Bureau of Agricultural Economics was organized for the express purpose of rendering assistance in solving the economic problems connected with the production and marketing of farm products. These problems grow out of the characteristics of the industry itself as well as from developments that take place within the industry. The business of farming is influenced by climatic and other hazards and by the individualistic character of the industry. While the manufacturer can shape and control his output in line with the requirements of the market, the farmer can exercise such control only within limits. Agriculture, furthermore, is a highly competitive industry. Every farmer in this country competes with more than 6,000,000 other farmers. Perhaps no less severe is the competition he has to meet from farmers in foreign countries.

Some of the more difficult problems confronting the industry have grown out of the specialization and commercialization of farming. As agriculture has spread over the Nation and as specialized forms of farming have developed in regions especially adapted to them, the distance between producer and consumer has greatly increased. This widening gulf between

producer and consumer has made it more difficult for the farmer to appraise the needs of consumers and has materially increased the cost of distribution.

In addition to the economic problems within the agricultural industry, there is another group of farm problems which are influenced by public policies. The farmer's welfare is influenced, for example, by State and National policies bearing on taxation and credit, land utilization, and transportation. These and other phases of the situation have been greatly aggravated by the depression following the World War. The impairment of the purchasing power of European peoples, the maladjustment in production in relation to demand, as well as the heavy debts that were contracted during and immediately after the war, have given rise to problems of a serious nature.

The Bureau of Agricultural Economics is rendering several types of service for the benefit of those who are engaged in or interested in agriculture. One of its most important services is to provide information of current interest and immediate value to the farmers in planning their production and marketing programs. The estimates of domestic crop production



have been made for many decades and have been developed to a relatively high degree of perfection. These statistics on production recently have been supplemented with detailed statistics on production in foreign countries which are compiled in cooperation with other departments of the Government, as well as in cooperation with governmental agencies abroad. In addition to this statistical service on crop and livestock production, a companion market news service has been spread over the entire country, providing timely information on supplies on hand, prices, and movement of various commodities. These production and marketing statistics are given wide distribution through all available channels and are widely used by producers, dealers, and consumers.

In addition to providing this current information on the production, prices, and movement of agricultural commodities, a more specialized service has been developed through which the bureau seeks to aid in analyzing the facts which have a bearing on the production and marketing of agricultural products. This service is given through the agricultural outlook reports which summarize and interpret all available information which may serve the farmer in determining how much and what to produce, on the basis of the price which will probably prevail at the time his products are ready for the market. Every year surveys are made by the bureau covering the intentions of the farmers as to plans for planting and livestock breeding. The results of these surveys are published in time to permit farmers to alter their plans so as to help eliminate serious overproduction or underproduction. These reports have been very helpful to farmers in meeting changing conditions.

Another service which has grown to large proportions is the bureau's work in the standardization and inspection of farm products. As the distance between producer and consumer has widened it has become increasingly necessary to establish standardized grades for the various commodities in order to facilitate transactions between seller and buyer. The bureau has established grades for a large number of the most important agricultural commodities, and farmers are now in position to know the grade and quality of many of the products they produce and the current price they should command in the market. The inspection service of the bureau is proving very helpful in ironing out

difficulties that arise between buyer and seller.

Fundamental to and underlying the service work of the bureau are the analytical studies of various problems. These studies afford the basis for adjustment in production and farm organization and should provide also the basis for sound policies for the future development of agriculture. The farmer, just like any other business man, must fully reckon with competition both at home and abroad. Many of the studies now made by the bureau aim to point out, as one of their primary objectives, how farmers may effectually meet this competition. It frequently happens, also, that the agriculture of a certain region may be badly adjusted. Unsatisfactory conditions such as these are being studied to lay the foundation for sound readjustments.

Careful studies of prices are being made to ascertain as nearly as possible the various factors that influence prices for farm products. The results of price studies are of fundamental importance in developing the most effective production and marketing programs. Studies are made of the manner in which farms are now being operated in various parts of the country, for the purpose of ascertaining the most efficient farm organization and farm practices. The bureau's studies of land utilization and land values are proving helpful in determining sound policies for the development of our lands. Studies of credit are uncovering weaknesses in our present credit structure and suggesting ways in which both Federal and commercial credit agencies may serve agriculture more effectively. Studies of farm insurance aim to show how the hazards of farming may be reduced. More recently studies have been made in taxation to determine to what extent farmers are carrying an undue share of the tax burden and how this burden may be more equitably distributed.

Undoubtedly some of the most important problems of the bureau are in the field of marketing. Intensive research covering the physical and biological problems of production has been carried on for many years by the department, but it is only recently that the economic problems of production and marketing have been given the attention they deserve. Some studies are now under way to ascertain the effect of marketing policies, gluts, and the adequacy of terminal facilities upon prices received by farmers. Other studies are being made to ascer-

tain the efficiency of existing marketing agencies.

Perhaps the most outstanding work of the bureau in the field of marketing is in the field of cooperation. The work of the bureau in this field will be greatly enlarged during the current year in carrying out the provisions of the cooperative marketing act, approved July 2, 1926, which provides for the organization of a division of cooperative marketing in the Bureau of Agricultural Economics. Through this division critical studies will be made of existing cooperatives to determine how they may function more effectively. Closer contacts will be maintained between the 12,000 cooperative organizations and this department, and all information bearing on the problem of cooperative marketing, as well as all statistical and economic information obtained by the bureau which may be of practical value to these organizations will be furnished them.

The various regulatory acts administered by the bureau which provide for the regulation of the marketing of various commodities, such as cotton and grain, supplement the research work of the bureau in making possible the more efficient marketing of products and in eliminating many uneconomic practices and much waste. The activities under the United States warehouse act have increased manyfold in the last five years and are becoming increasingly useful. This act makes possible the safe storage of farm products and provides the farmer with collateral for loans with which he can carry his product and market it in an orderly way.

Each year more cooperation is being received from the various States in carrying on the work of this bureau. Thirty-one States are now cooperating in preparing the crop and livestock estimates and in distributing statistical and economic information to producers in the various States. Many State agencies and local organizations assist the bureau in maintaining temporary market news field stations which keep the producers informed in regard to supplies and prices in the principal cities, thus enabling them to ship to the most favorable markets. The shipping-point inspection service, which enables any shipper to obtain a certificate which is prima facie evidence in the courts of the United States as to the quality and condition of his shipments, is carried on very largely through the cooperation of State and local agencies.

The various lines of the work of this bureau, in short, are very closely coordinated and cooperation is maintained with other bureaus of this department and other departments of the Government in bringing to bear on the farmer's problems united effort and all available information.

## DIVISION OF FARM MANAGEMENT AND COSTS

H. R. TOLLEY, *in charge*

The work of this division centers attention upon the individual farmer's effort to obtain a greater return by utilizing all available information concerning profitable farming systems, production costs, and practices, present or prospective market conditions and prices, and good farm-management principles. In this work particular attention is given to regional problems which involve one or more States where a similar type of farming is followed. In this way the results of investigations in a particular locality are made useful to farmers operating under similar conditions in other localities of the same region.

By means of careful studies of local problems farmers are rendered assistance in keeping their production programs in line with changing market conditions. In these studies the information assembled in connection with the bureau's work in estimating crops and livestock, market-price analysis, and in connection with the agricultural outlook are utilized and interpreted in the light of local conditions affecting their application.

## STATE AGRICULTURAL PROGRAMS

Studies have been conducted in Louisiana, southern Mississippi, New Hampshire, Kansas, and Idaho with a view to providing local farmers with a more adequate basis upon which to plan their production and marketing programs. Attention has been given to adjusting production to meet the needs of local markets, where this can be done with profit. Markets outside the area studied are also considered and the necessity of keeping production in line with market requirements as to quality and quantity is pointed out.

A study of Louisiana and southern Mississippi showed that the agriculture of the New Orleans trade territory is breaking away from highly specialized cotton, cane, and rice plantations. The survey indicated that a



profitable increase of cotton production would result from a greater use of the richer delta and bottom lands for this crop and the use of some of the worn-out hill lands of the State for reforestation and grazing purposes. The need for improvement in cotton-marketing methods was emphasized. It was pointed out that the market facilities for handling fruits and vegetables produced on near-by farms were totally inadequate and that this situation, together with insufficient market news service, was responsible in part for the failure of local farmers to produce a larger portion of the food products consumed in New Orleans. Dairy production was found to be on an inefficient basis, the production per cow being low, and little if any attention being given to the feeding of balanced rations.

In New Hampshire an analysis of the home-market demand for farm products that can be produced in the State was made. The estimated yearly purchases of farm products from local farmers and from outside the State were obtained. In the case of some commodities analysis showed that farmers were already supplying their local market during the local harvest season, although large quantities were being shipped into the State during the remainder of the year. The study indicated the possibility of expanding the production of some commodities, such as potatoes, provided they were grown in acreages sufficiently large to make the use of efficient machinery and production methods possible.

Studies in other localities brought out facts which were helpful in improving farm-production programs. In all cases the results of the surveys were given immediate publicity in the locality studied and it has been noted that the suggestions of the bureau have been very generally followed.

#### ADJUSTMENT IN WHEAT-PRODUCING REGIONS

Work was begun on a study designed to ascertain the conditions under which it will pay wheat producers of specific areas to increase or decrease their wheat acreage. In each type of farming area studied the combination of crop and animal enterprises is worked out which is likely to prove most profitable under varying conditions of production and with different prices for wheat, and for alternative enterprises.

Relative costs of harvesting and threshing wheat by different methods

are being considered, as well as the merits of different varieties of grain and their adaptability to combine harvesting and the grade and keeping quality when harvested by different methods. This work is being done in cooperation with the Bureaus of Public Roads and Plant Industry and the State agricultural experiment stations.

A review of the agriculture of the Big Bend Country, a wheat-producing region in eastern Washington, was prepared in cooperation with State agencies. This review emphasized the fact that the area is subject to periods of high and low annual precipitation. During years of high yields and good prices thousands of acres of land that was best adapted to grazing were brought into cultivation. Subsequent years of low yields and poor prices have in turn forced the abandonment of much of this land. A bulletin setting forth the methods used by the most successful farmers in the area has been prepared.

#### ADJUSTMENTS ON VIRGINIA TOBACCO FARMS

In cooperation with the Virginia Polytechnic Institute a representative of the division has assisted farmers in Charlotte County, Va., who have followed the suggestions and recommendations growing out of a study of profitable methods and practices in the area.

#### THE FRESH PEACH INDUSTRY

During the past year this bureau, in cooperation with a number of State agricultural institutions and other agencies, undertook to assemble available data and to collect other data which would be of value to growers and agricultural workers in planning future programs of peach production and marketing. This study included 26 different States, and reports as to the age and variety of nearly 43,000,000 peach trees in commercial orchards were received from about 21,700 growers located in all the important producing sections.

A report dealing with production areas, consumption, marketing, competition, and prices has been issued. Additional reports having to do with the cost of developing and operating peach orchards in the leading producing areas, and the distribution of trees by age and variety, will soon be issued. This study brings out conclusively the necessity for peach producers to make preparations for dis-



posing of an increased production of peaches during the next few years.

#### **COST OF PRODUCING CORN, WHEAT, OATS, COTTON, AND POTATOES**

A study of the cost of producing corn, wheat, oats, cotton, and potatoes was continued along lines pursued during previous years and the results were published in the June, 1926, Supplement to Crops and Markets. Comparisons with the years 1922, 1923, and 1924 have also been worked out and published. In arriving at these costs reports from over 17,000 farmers were received and analyzed. Bulletins on the cost of producing wheat and the cost of using tractors, horses, and combines under dry-farming conditions in the Pacific Northwest have been prepared.

#### **RANGE-CATTLE PRODUCTION**

Studies embracing the important range cattle producing areas of the United States are being carried on in cooperation with the Bureau of Animal Industry and State experiment stations and extension services. In addition to determining the practices and costs of beef production, the studies are designed to show the comparative advantages and disadvantages of different types of livestock in the different areas and the probable market demand for them. Studies under way will give information on the extent to which the present system of ranch and general farm organization should be modified to meet inherent weather risks and present and prospective economic conditions. These studies cover the northern Great Plains and the range area in the Southwest, including New Mexico, Nevada, Utah, and part of Texas.

#### **LIVESTOCK IN THE COASTAL PLAINS REGION**

A study of the place of livestock in the southern coastal plains region was started to determine the methods of management and the organization under which dairy cows, beef cattle, and hogs can be profitably included in the systems of farming in the southern coastal plains region.

#### **BEEF CATTLE IN THE APPALACHIAN REGION**

In this area a general survey of the methods and practices in producing grass-finished beef and of the influence of various methods of production on the market value of the animals is being followed by a detailed study of

methods of fattening cattle and the organization of beef-cattle farms. The study of the influence of production methods on the market value of the animals and of the factors which influence the quality and palatability of meat is being continued in cooperation with other agencies.

#### **CATTLE AND HOG PRODUCTION IN THE CORN BELT**

Reports dealing with the most profitable methods and practices of cattle feeding in different sections of the Corn Belt have been prepared. Studies of the most profitable methods of pork production on Corn Belt farms were continued during the year, and timely reports issued to cooperating farmers and to other farmers in the area. These reports summarized the results of the investigations and indicated ways and means of increasing returns from pork production.

#### **HOG PRICES AND SUPPLIES**

A detailed statistical study of variations in the supply and price of hogs has been made which should aid farmers in their efforts to keep hog production adjusted to market demand. The adjustments made by successful farmers are contrasted with those made by less successful farmers who base their plans entirely on present prices without attempting to analyze the situation as to probable changes in market conditions when future supplies are ready for market. The study demonstrates the necessity for farmers to keep in touch with market developments, production trends, forecasts, and outlook reports as a means of keeping their production properly adjusted and of obtaining the largest net returns.

#### **DAIRY PRODUCTION**

Economic studies of the dairy industry have been continued in cooperation with State agencies. In Wisconsin an analysis of farm records to show the relation between feeding and production was made. This study shows very clearly the significant factors responsible for variations in milk production, and indicates ways in which Wisconsin milk producers can reduce their costs of milk production. It also points out the ways in which production practices should be modified to meet changing costs and prices. Certain weaknesses in present dairy-feeding standards were brought out by the study. Similar studies were made in other States and information is being

prepared which will be of value to farmers in forecasting the future trends in dairy production.

### POULTRY PRODUCTION

Information bearing upon all phases of the poultry industry has been compiled. The census data relative to poultry and egg production for typical counties in every State have been tabulated according to the size of flocks on each farm, which will provide a better basis for a description of commercial and farm-poultry production than has been available heretofore. Near the close of the year arrangements were completed for a detailed survey of methods and practices in poultry production in important producing areas in New York State.

### TYPES OF FARMING

Studies of the geographical distribution of types of farming were continued and data obtained from the 1924 census are being analyzed and compared with similar data for 1919 and 1909. Maps showing the relative importance of different crops and kinds of livestock in each county in each State are being prepared, which are of value in studying the factors that control types of farming, since a careful study of the localities in which a given change in type of farming is occurring often reveals the causes of such change. The maps thus far made indicate a more or less general return to the types of farming prevailing at the time of the 1909 census. The great extension of the wheat acreage which occurred in 1919, and which seriously unbalanced the agriculture of many sections, has for the most part disappeared and wheat appears to be gradually assuming a position in American agriculture more in keeping with present economic conditions.

### FARM-BUSINESS SURVEYS

The results of 71,516 farm-business records from 450 localities in 45 States were summarized and prepared for publication in the 1925 Yearbook. Frequency tables showing the number of farmers having incomes of different amounts have been prepared for different localities. These are based upon 46,748 labor-income records and will be made available for different localities and for different periods before and since the war.

### STUDIES IN SOUTHERN STATES

The field route work in connection with the study of sugar-cane production in Louisiana carried on in cooperation with the office of sugar plant

investigations of the Bureau of Plant Industry and the Louisiana experiment station was completed at the close of the crop year. A report being prepared includes a detailed analysis of methods and practices in sugar-cane production in the area and of the organization of the farms studied.

In Mississippi a study of the combination of enterprises and methods and practices in production has formed the basis for recommendations as to changes in practices and management. The farmers of the area petitioned for the continuance of this work which in addition to its immediate benefit to the farmers is an important experiment and demonstration in farm-management work.

In South Carolina a farm-management survey was made of a community in Greenville County. A new farm-business record book, farm-labor record book, and a book for keeping an account with cotton have been prepared for the use of South Carolina farmers.

In Arkansas the work in cooperation with farmers and farmers' wives in keeping farm and household accounts has been continued. In connection with the study of livestock production in the coastal plains region of South Carolina, Georgia, Florida, Alabama, and Mississippi a great deal of statistical and historical information relative to the agriculture of this region has been assembled and analyzed and will be presented as a part of this general study.

### FARM RETURNS

Reports on the general results of farming in 1925 submitted by farmers were tabulated. A return of \$1,297 to the owner-operator for the use of \$17,149 of capital and the labor of the farmer and his family is the average shown by 15,330 farms for 1925, compared with \$1,205 by 15,103 farms for 1924, \$1,020 by 16,183 for 1923, and \$917 by 6,094 farms for 1922.

The return of \$1,297 per farm in 1925 includes \$1,074 cash, the excess of cash receipts over cash outlay for current operating expenses, and an increase of \$223 in the inventory of crops, livestock, machinery, and farm supplies from January 1, 1925, to January 1, 1926.

In addition, the farm family had food produced and consumed on the farm, the estimated value of which on the 13,494 farms reporting the item was \$283, and fuel from the farm and use of house, the values of which were not reported. On the other hand, in-



terest averaging \$225 paid on indebtedness, and outlays for improvements averaging \$127, were not included in the computation of current cash operating expenses.

Although the averages of the reports indicate real improvement in farm returns for the country as a whole, distribution of the reports by geographical divisions shows that the improvement over 1924 was largely in the North Atlantic, East North Central, and Western States, the West North Central States showing practically no net change, and the Southern States showing less favorable results.

#### FARM RECORDS AND ACCOUNTS

Studies of farm organization and management problems by means of farm records and accounts were continued in selected types of farming areas during the year in cooperation with the different State agricultural experiment stations. The data made available by these studies are presented to farmers in connection with market outlook information and experimental data, and since follow-up work is necessary in getting the records an opportunity is given to observe carefully the particular form in which farm-management data of this kind is most likely to stimulate action.

After a study of this kind has been continued in an area for a time many of the cooperating farmers become outstanding examples illustrating the possibilities of improvement in the farm-organization plans and practices of the area through a careful study of the business and an application of good farm-management principles. The farm tour is used extensively in carrying results of this kind to large numbers of other farmers.

The reports carry data showing the variations in the production requirements and financial returns on different farms in the area. The reasons for these variations are pointed out and illustrations of particularly effective methods and practices and systems of farming are shown in detail. Outlines showing systems of farming that the route data and other available information point to as being well adapted to the conditions and different sets of resources found in the area are presented.

#### DIVISION OF CROP AND LIVESTOCK ESTIMATES

W. F. CALLANDER, *in charge*

The ever-increasing demand by public and private agencies for the basic

data concerning acreage, production, and value of crops; numbers of livestock on farms, farm prices, stocks and movement of livestock products, etc., and the growing realization of the important part that such information must play in any program for the improvement of agricultural conditions has been extremely stimulating and gratifying to the division. It has resulted in a marked increase not only in the volume but in the quality of the statistics gathered and published.

In addition to the technical staff of 73 statisticians and assistant statisticians in Washington and the field there are now on the lists of the division over 350,000 voluntary correspondents. These correspondents are about equally divided between the Washington and field-office mailing lists. During the year approximately 9,000,000 schedules were sent out through the Washington and field offices. Over 225 different kinds of schedules were used, covering all phases of crop and livestock production and growth, prices, land values, wages, population changes, stocks, crop varieties, etc. In 31 States the work is carried on in cooperation with the State department of agriculture or other State agency, Oregon and West Virginia being added to the lists of States cooperating during the past year. Forty-one field offices have been maintained.

#### LIVESTOCK STATISTICS EXPANDED

The livestock work is being expanded so as to furnish producers more complete information as to the amount of livestock produced each year as well as to changing numbers. At a conference held recently in Topeka, Kans., it was decided to undertake the estimation of the actual annual production of the various species of livestock and the value of this production by States and to publish such estimates next year.

A beginning was made in 1925 in estimating the size of the lamb crop. This year an estimate is being made of the actual number of lambs saved to June 1 in both 1925 and 1926, together with the number of breeding ewes as of January 1 each year and the percentage of ewe lambs being kept for breeding ewes. These estimates are based largely upon returns obtained through the rural carriers of the Post Office. Through these reports sheep producers can be kept as completely informed as to trends and changes in sheep production as are



hog producers through the pig surveys, which were started in 1922. It is planned to furnish more detailed information as to changing cattle numbers from year to year by separating the January 1 estimates of total numbers by States into various classes, such as cows, heifers, steers, bulls, and calves.

Statistics with respect to dairy animals, milk production, and poultry are less developed than for most other classes of agricultural products. Recently an effort has been made to develop a program of statistics for these classes of products. The demand for this information has increased greatly during the last two years with the development of extensive dairy and poultry organizations.

#### FARM PRICES PUBLISHED

After several years' work, farm-price data have been assembled and prepared for publication as a statistical bulletin in order to meet the increasing demand for better information on farm prices. These price data have been organized by States and include the monthly prices of crops beginning with 1908, monthly prices of livestock and livestock products beginning with 1910, the December 1 prices of crops, the January 1 values of livestock, wage rates since 1866, land values beginning with 1912, and in addition the values of crops and livestock for the 1925 Federal census by crop-reporting districts.

Experiments have been conducted in collecting the prices paid producers in commercial producing areas as distinct from the regular farm prices. As a result the schedule has been shortened and a special service to the price reporters has been developed. This service is in the form of a "special news letter to price reporters" which contains a digest of crop and live-stock reports and an abstract of the price and business situation material.

#### MORE ACCURATE ACREAGE ESTIMATES

Heretofore the acreage of spring wheat, oats, barley, and hay was estimated on June 1. In 1926 the estimates of acreage of all spring-sown crops and hay as well as the revision of fall-sown acreages were issued as of July 1. This change was made in the interest of accuracy. The principal source of information as to acreage changes is found in the individual farm-acreage reports, which are obtained from a large number of unselected individual farms showing

acreage in each crop the current year and the past year, from which the changes are computed. The crop meter is also becoming a valuable aid in determining acreage in States and areas which are reasonably level or gently rolling.

#### NEW QUARTERLY REPORTS OF STOCKS

Quarterly reports of stocks of wheat, corn, and oats in interior mills and elevators and on farms were inaugurated during the year. It will require two or three years, however, to develop a complete system of reports.

#### RECOMMENDATIONS OF STATISTICAL COMMITTEE

In February the advisory statistical committee, which is made up of a number of the leading statisticians of the United States, was called to Washington to review the work of this division. A number of recommendations were made, a part of which are shown below:

That the objective methods of ascertaining acreage such as motor meters, pole counts, etc., should be still further developed and utilized.

That an additional research statistician should be employed and afforded every facility for making further investigations, \* \* \*

That crop estimates based upon reports of condition be continued, but that such estimates of probable yield be more carefully safeguarded from possible misinterpretation by explanations or warnings or by stating the upper and lower limits which a subsequent combination of favorable or unfavorable changes in weather and infestation conditions may render possible.

That the estimation of dairy and poultry products be developed and continued as a regular feature of the work \* \* \*

The committee is impressed with the improvements and progress in the livestock work of the bureau, such as the pig surveys, investigations of beef cattle and lambs on feed, milk and egg production, and it approves of the plan to estimate production of livestock as to numbers on specific dates. The committee, therefore, recommends that this work be pushed with vigor and that every effort be made to obtain accurate information and to extend the scope of the work with a view to affording a guide to farmers in their future production.

The committee approves the plan of omitting earlier reports of acreage of spring crops and the concentration on securing the most accurate data possible for such a report on July 1.

The committee believes that the biweekly estimates and reports on the condition of the cotton crop are unnecessary and unwise. If such reports must be made because of statutory requirements, they should be so made as to emphasize the monthly reports which are comparable with those of previous years and to indicate that the midmonthly reports are merely indicative of changing conditions \* \* \*

The committee approves the plan of undertaking an annual census of agricultural townships or smaller areas. The committee believes that the results of such

a census will be of great value as a check on the returns obtained by the Bureau of the Census in its quinquennial enumeration and upon the other sources of information utilized by your bureau in its estimates.

The committee has been impressed most favorably by the monographic studies and compilations of statistical data covering periods of years that have been prepared in your bureau, and it is of the opinion that there is still much that might be done along this line. \* \* \*

## DIVISION OF COTTON MARKETING

ARTHUR W. PALMER, *in charge*

### STANDARDS FOR EXTRA WHITE COTTON PROMULGATED

No changes or modifications of existing standards for grade for American upland cotton were made during the fiscal year, but five standards for upland cotton of extra white color were promulgated at the urgent request of producers and handlers in the irrigated sections of the Southwest whose cotton was not readily classified on existing standards. These standards become effective August 1, 1927, but prior to that date they may be used as tentative or permissive standards.

### REVISED STAPLE STANDARDS

Although the purpose of the order of the Secretary of Agriculture, dated August 25, 1918, establishing staple standards was to make the inch rule the standard of staple length, it has been apparent from time to time that differences in character of cotton used in the preparation of official types to illustrate staple lengths tended to occasion certain difficulties in the application of the staple standards.

To remove the possibility of such difficulties the department invited leading organizations of cotton growers, merchants, and spinners to send representatives to Washington July 27, 1925, to collaborate in a decision as to the proper character of the cotton to be used throughout the range of the length standards. Cotton of normal, uniform character and medium body was selected and this character is to be maintained in all issues of the new length types. Following this meeting the Secretary signed an order, to become effective August 1, 1926, officially recognizing the types selected as "original representations of the official cotton standards of the United States for length of staple."

### DEMONSTRATION OF STANDARDS

Demonstrations of the standards in European markets have been continued. The bureau's technical repre-

sentative, through contact with European trade organizations, has aided materially in bringing about the successful and satisfactory use of the standards in all of the larger consuming countries in accordance with the universal-standards agreement. In the conduct of demonstrations and in meeting requests for explanations of the standards many questions of a technical nature affecting this work of the department have arisen. The services of the representative in these matters have been most valuable.

Through cooperation with various colleges throughout the Cotton Belt very helpful demonstration work has been done also, and the Federal standards are becoming much better understood.

### CLASSIFICATION OF COTTON

In accordance with the United States cotton futures act, all cotton intended for delivery on future contracts is classified by officers of the Department of Agriculture. The total number of bales classed in the regular and preliminary work amounted to 344,764 for the fiscal year 1926. A feature of the year was the large increase in classifications for delivery at Houston and Galveston, the total bales involved in the regular and preliminary work being 123,319, compared with 23,314 during the previous year. Houston and Galveston are the delivery points for cotton tendered on futures contracts entered into on the Chicago Board of Trade.

The classification work continued to be self-supporting. Collections during the year amounted to \$133,556.91, disbursements \$124,992.05. Fees are increased or decreased as the condition of the funds warrants.

Section 4 of the United States cotton standards act provides that any person who has custody of or a financial interest in any cotton may submit the same to the department for classification. The boards of cotton examiners at New York, New Orleans, and Houston which classify cotton intended for delivery on future contracts have been designated to perform this service also, and the board previously established in Washington for the purpose continued to hear appeals. Total collections for this service amounted to \$14,224.10, including the fees collected for licenses issued to classify cotton.

### LICENSING OF COTTON CLASSERS

The purpose of the licensing of classers is to make it possible for



producers to obtain a fair classification of their cotton by men of recognized competence. The employment of licensed classers by the shipping associations and the trade generally will encourage the full use of the universal standards wherever trading in American cotton is carried on.

The practical tests thus far have shown that the variation in the judgment between classers of established reputations not familiar with the universal standards is greater even than the department had believed to be the case. To pass the test the applicant must be a competent judge of cotton and have thorough understanding of the universal standards. Many applicants who failed in the test have attended the classing schools conducted at the agricultural colleges throughout the Cotton Belt during the year and after two or three weeks of intensive study of the standards were able to qualify.

#### CLASSING "SNAP COTTON"

An important problem developed in connection with the eligibility for tender on future contracts of so-called "snap cotton" under section 5 of the cotton futures act, due to uncertainty as to the value of such cotton in comparison with picked cotton of like grade. To insure a just and careful final classification of all cotton of this character submitted for certification the chairmen of the various boards of cotton examiners were instructed to refer to Washington all requests for the review of the classification of any cotton believed by them to have been snapped.

#### NEW INSPECTION OFFICES OPENED

An office was opened in Savannah, Ga., at the urgent request of the members of the Savannah Cotton Exchange, which had established an inspection bureau intended to function in accordance with the regulations under the cotton standards act. A similar office was opened in Little Rock, Ark., at the request of the members of the Little Rock Cotton Exchange. Samples drawn under official supervision at these points from cotton stored in approved and bonded warehouses are submitted for classification to the boards of cotton examiners in New York and New Orleans, respectively.

#### SPOT MARKET QUOTATIONS

Supervision is maintained over the quotations of designated spot markets

under authority of the United States cotton futures act. During a part of the past year, when inactivity prevailed in the spot markets, new problems developed in the making and verification of these quotations. In March, 1926, a committee of the department visited a number of the designated markets and obtained data of actual sales. A further study of methods employed in these markets is under way.

#### COTTON NEWS SERVICE EXPANDED

The cotton price quotation service has been maintained in five districts of the Cotton Belt. Reports of purchases and sales of cotton are gathered from country merchants, country buyers, dealers, brokers, commission merchants, factories, mills, and others who buy or sell cotton in important markets and concentration points.

Weekly bulletins are prepared and published at the five southern offices showing the prices at which various grades of cotton were actually purchased and sold. The information can be obtained by telephone and telegraph by anyone who requests the service and pays the transmission expense involved. The bulletins are mailed free of charge to anyone requesting them. In addition to cotton price information there were included cottonseed and cottonseed products price data, such as for linters, hulls, cake, meal, and oil. Newspapers and periodicals continue to publish the price data and other information furnished them from Washington and the field offices, thus making the service available to a large number of interested persons who would not otherwise be reached. The facilities for disseminating cotton prices by radio were increased.

#### SPINNING TESTS

Spinning tests were conducted to determine the relative intrinsic value of each of the nine white grades of American upland cotton. The average percentage of visible waste varied from 5.5 per cent on grade No. 1 to 14.44 per cent on grade No. 9. The higher grades consistently produced the stronger yarns and bleached yarns of all the grades were weaker than the corresponding gray yarns, while the mercerized yarns were stronger. The lower grades produced less bright yarns than the higher grades. The



effect of finishing was practically the same for eastern and western yarns.

The results of the 1924 Texas test tend to substantiate the findings of the 1923 test; that is, for breaking strength the varieties ranked as follows: Lone Star, Acala, Kekchi, Rowden, Mebane, Hoground, Kasch; and for waste content, Lone Star, Mebane, Kasch, Kekchi, Hoground, Acala, Rowden. A third test is being made of the 1925 crop.

Although South Carolina varieties for 1925 were grown under drought conditions, adverse to the production of cotton possessing high spinning quality, nevertheless satisfactory yarn was spun from these varieties when the yarn numbers were adapted to the staple length of the particular variety.

A test of picked and snapped cottons from Texas and Oklahoma, although not presented as conclusive, indicates that snapping as a method of harvesting lowers the grade of cotton by about two grades; that when efficient boll-extracting equipment is used the spinning quality of the cotton is not noticeably affected; that the percentage of visible waste in snapped cotton is not materially greater than in picked cotton of equal grade; and that, taking these results as typical, the snapping of cotton under the prices and conditions which prevailed in 1925 resulted in material loss to the grower when compared with the amounts that might have been realized had the cotton been picked. The loss was heavier when the snapped cotton was sold in the seed.

Technical studies were made of fiber length and strength in an effort to correlate these characteristics with yarn strength. Samples were tested for strength by the bulk method, whereby from 6,000 to 8,000 fibers were broken simultaneously. A report covering this bulk method of determining fiber strength will be published.

The practical advantage of such a method is that it would afford a measure of staple quality without resorting to spinning tests. This is of importance both in the development of standards and in cotton breeding. Under the present system State experiment stations and plant breeders are forced to increase a particular variety from four to six years before an amount of fiber sufficient for a spinning test is produced. Under the bulk method of testing the fiber from a

single stalk of cotton will provide a sample large enough for the test.

#### COTTON MARKETING STUDIED

During the year studies of several important phases of cotton marketing have been completed, and a number of publications covering the marketing of cotton, both in the United States and various European countries, are now available. In cooperation with Clemson College, in South Carolina, a study was made of marketing practices and of the relation of price and quality in typical producing areas of South Carolina. The series of analytical statistical studies, begun during the previous year, have been completed and have been submitted for publication under the title "Factors Making the Price of Cotton." Studies of the distribution and use of the American crop and the nature of the demand for the various qualities are in progress.

#### COTTON-HANDLING INVESTIGATION

Work on the tare problem has made good progress. A wide assortment of materials customarily used for covering baled cotton had been collected, and tests of breaking strength, and practical tests of the serviceability of the materials, when put to high density compression, have been made.

Other studies include the economies to be had from the use of a lighter tie, the factors governing the price of bale coverings and the practicability of plan for standardizing bagging, ties, and patches.

In the testing of patching material it was found that a durable patch 24 inches wide and 48 inches long weighing 2½ pounds was the minimum size patch which would both withstand high density compression and cover the sample holes.

#### THE STANDARDIZATION OF COTTON-SEED AND COTTONSEED PRODUCTS

Further studies of cotton-seed have been made with a view to devising a method of grading and evaluating the supplies for oil-mill purposes.

The foreign-matter content has been found to vary from less than 1 per cent to as much as 40 per cent, the moisture content from below a normal of 10 per cent to above 25 per cent, the kernel or meats content of clean seed from below 48 to above 62 per cent. A combination of these variables, in round numbers, makes the kernel content of the gross ton to vary

from about 40 to 60 per cent. Seven tentative grades based on the kernel content have been proposed.

A much greater variation in the intrinsic value of different lots of cottonseed was found than had been supposed. The kernels or meats contain the oil and the residue of the meats constitute the cake. The oil forms approximately 53 per cent of the value of all the products of cottonseed and the prepared cake or meal approximately 35 per cent. The oil content of the meats was found to vary from about 25 to 40 per cent, or from 250 pounds of oil per ton to 400 pounds per ton in the proposed grade No. 4. The protein content of the cake was found to be in approximately a reverse ratio to the oil content.

The oil content has been found to be approximately correlated with growing conditions, so that the value of any lot of cottonseed can be fairly accurately estimated for the basis grade when the oil-in-meats factor of the place of origin of the seed is known.

The results of these studies have been reported to the conventions of the interstate and several State associations of cottonseed crushers and have been favorably received.

## **DIVISION OF FRUITS AND VEGETABLES**

WELLS A. SHERMAN, *in charge*

### **MARKET NEWS SERVICE**

Ten years of experience have served to standardize to a large extent the methods of gathering and disseminating reports on supply, demand, movement, and prices of fruits and vegetables and other current market information, although readjustments and minor changes must constantly be made. The bureau's 7,500 miles of leased telegraph wires continue to be the chief means of transmitting information between the various branch offices and Washington and from one branch office to another. This information includes shipment reports, arrival and price data, and statements regarding local conditions in producing sections and terminal markets, etc.

The information is compiled and given wide publicity from Washington and the branch offices and field stations by means of mimeographed reports, radio, telegraph, telephone, bulletin boards, and the press. The products covered by daily telegraphic reports include 34 of the most important fruit and vegetable crops of the United States. The total number of

mimeographed market reports distributed during the year from Washington and the branch offices was approximately 12,150,000—an increase of 12 per cent over the preceding year, and concrete evidence of an increased realization of their value. A constantly augmented demand for these reports as a basis of settling railroad claims testifies to their accuracy. The mimeographed reports also furnish the basis for statistical studies and research work. Many dealers and shippers maintain complete files of the reports for reference.

Development of new contacts and outlets for the reports through the press and by radio has continued.

### **COOPERATION OF TRANSPORTATION LINES**

The volume of carload shipments reported each year has gradually increased. Wire reports cover 34 products and several additional commodities are reported by mail. The total of 978,927 cars of 38 products reported last year represents a net increase of about 10,000 over the year 1924.

Daily telegraphic reports on selected perishable products are received at Washington from several hundred transportation lines, these reports showing the number of cars originating in each division superintendent's territory. About 73 of these reports are "consolidated wires," each covering an important railroad system or major portion of a system. Approximately 400 individual division superintendents or other reporting officials, chiefly of smaller transportation lines, send daily wires.

About 15,000 local freight and express agents are held accountable for monthly (station) reports by mail, covering a greater number of products than those in daily wires.

Effective June, 1926, an arrangement was perfected with the Canadian railroads to furnish a monthly statement of shipments of all car-load perishable freight originating in Canada and destined to points in the United States. It is hoped that the information to be furnished will give a more complete picture of perishable commodities imported into the United States from Canada.

### **COOPERATION IN MAINTAINING FIELD OFFICES**

The bureau receives the cooperation of State and local agencies in maintaining temporary field stations dur-



ing the heavy movement of important crops. In many cases these agencies have defrayed the major part of the expenses of such stations. Without such assistance it would not be possible to maintain the present program of service. In all, 36 field stations have been opened during the past year, in addition to the 17 permanent branch offices. At a number of points on the leased-wire system various States have established offices for the distribution of crop and market information which they obtain from the leased wire.

#### MARKET REPORTS ON PEANUTS

Quotations are obtained covering prices paid for farmers' grade stock and selling prices for shelled and unshelled peanuts, peanut oil, and at times peanut meal or cake. Supplementary information on prevailing prices in the producing areas is obtained from peanut brokers in the large consuming centers.

Weekly telegrams are received from bureau representatives in receiving centers which include car-lot arrivals and boat receipts, market conditions, and selling prices, or quotations in large lots of both cleaned and shelled peanuts and brokers' statements mentioned above. This information is supplemented by reports from the carriers and by information from foreign countries. Reports are issued weekly.

#### REPORTS ON HONEY AND BEESWAX

The market news service on honey and beeswax has been continued successfully. At present about 130 large beekeepers and honey shippers, scattered throughout the country from Vermont to Florida in the east to California and Washington in the west, furnish reports of market prices, conditions of colonies and honey plants, etc., that are combined for publication in the honey market news reports. Several times a year returns from thousands of reports of beekeepers, dealing with yield, condition of bees, etc., are tabulated by the division of crop and livestock estimates. Information is obtained by representatives of the bureau in large markets and import and export figures are obtained from the Department of Commerce. Mimeographed reports are issued twice a month.

#### UNLOAD REPORTS FROM PRINCIPAL MARKETS

Arrangements were made effective April 1 to obtain unload reports from 30 additional cities. It is of interest

that this proposed expansion—requested by many important dealers and shippers—received the practically unanimous approval of the subcommittees of the regional advisory board to whom it was submitted. These additional reports, when perfected, will give a country-wide picture of distribution of much value to those engaged in the marketing of perishables. The 66 cities now covered include the principal markets having 100,000 or more population.

In 25 cities, the bureau's own men obtain the unload information regularly. These reports of unloads of car-lot shipments are obtained each day from the railroads and express companies. Similar reports are received from important boat lines. Reports are submitted at the close of each month by railroad agents in 41 additional cities.

These data are of great value because they show the monthly and annual receipts of various products in large consuming centers, as well as the sources of supply. The bureau's representatives in various markets frequently prepare press releases for public distribution on the basis of these figures, and mimeographed summaries are issued regularly.

#### REVIEWS AND SPECIAL REPORTS

The Weekly Market Review of Fruits and Vegetables analyzes and compares the market movement and prices of the week, as compiled from the daily market reports and the Weekly Summary of Car-lot Shipments.

Each Tuesday the Weekly Summary of Car-lot Shipments is mimeographed and distributed. This publication is statistical in nature and summarizes in comparative columns the car-lot shipments of the principal fruits and vegetables as reported telegraphically by the carriers each day. It affords a valuable comparison of the past week's shipments with those of the preceding week and with the corresponding period of the year before. Totals are given for this season and last season to date, as well as grand totals for the past season—all on the basis of products and by originating States.

Great developments have been made in the line of special monthly or weekly reviews for particular papers, chiefly farm journals, in different parts of the country. A monthly market review tells of market trends during the preceding four weeks, in addition to outlining future prospects. An-



other review is prepared on the first of each month for the special benefit of seven papers that go to press early, and another on the 10th of the month.

The fruit and vegetable section of the weekly Marketgram is prepared for the daily editions of that special report, distributed through the Division of Information. These summaries of the latest developments of the preceding seven-day period describe important changes in market prices and conditions. The day's prices are abstracted from this report and published in the Daily Digest of the department. Special telegrams are prepared for certain newspapers and farm journals that have requested this service. These wires, some of them daily and others weekly, summarize the market situation on selected products and are published by the respective papers or other subscribers.

Summaries of the marketing of specific crops in important producing sections, including price, shipment, and production statistics continue popular. They command much attention and commendation and are being used by many as a basis for planning marketing operations for the succeeding year. The manager of one successful cooperative association refused to contribute toward the cost of issuing daily reports from a producing section office until he was assured of the prompt release of the summary following the close of the deal.

#### HEALTHY GROWTH IN INSPECTION SERVICE

The service covering the inspection of fruits and vegetables and the certification as to their quality and condition has made satisfactory progress both at shipping points and at the receiving markets. The total number of inspections made at receiving points was 32,531, an increase of 197 cars over the preceding year. The total number at shipping points was 165,529, or an increase of 34,442 cars. In addition to the inspections made for commercial interests, 38,889,636 pounds of fruits and vegetables were inspected for the Navy Department, 2,608,363 pounds for the Marine Corps, and approximately 8,600,000 pounds for the laid-up fleet and for various steamship lines. Very substantial savings are effected for the Federal Government through the inspection service.

#### RECEIVING POINT INSPECTIONS A BENEFIT TO EXPORTERS

There has been a material increase in the number of export inspections of

boxed and barreled apples in New York City. Exporters are depending more and more upon the Federal certificates as an aid in closing their financial transactions at the time the fruit is delivered to the steamship companies.

#### RAILROAD COMPANIES USE INSPECTION SERVICE

Under special contract with a large railroad company, arrangements were made for the preliminary inspection of all cars arriving in Cleveland over that line and for the complete inspection and certification of those cars which showed broken packages or off-condition products. It is expected that approximately 4,500 cars will be inspected during the year. This work is yet in an experimental stage but seems to be progressing favorably in accordance with original plans. Many inspections are made for other railroad companies throughout the United States.

#### SHIPPING POINT INSPECTIONS

The greatest increase in number of inspections made was in California, this being due largely to the very great increase in the number of grape inspections, 36,069 cars having been inspected in 1925-26, compared to 18,783 in 1924-25.

An increased willingness has been shown in practically all sections to accept certificates on cars which failed to meet the grade requirements. Shippers are finding that they can sell cars which are slightly under grade at only a slight reduction if they support their statements of the quality of such cars by Federal-State certificates. Reductions in price on slightly off-grade cars are usually much less if made at shipping point than if made after the product has passed into the hands of the buyer.

The shipping-point inspection work is practically all done under cooperative agreements between the department and the various State agencies. Fees are collected from the applicants for inspection making the service practically self-supporting.

Of the total 165,529 cars inspected at shipping points, there were 225 re-inspections made at receiving markets, 106 of which sustained the original inspection. To reduce the number of re-inspections and reversals to as low a figure as possible, special efforts have been made to call errors at shipping point more quickly to the attention of supervisors so that they may be cor-

rected before the same error can be made on other cars. In order to prevent errors in reinspections in receiving markets, it was required that the Washington office be advised of the findings and secure approval before reversal certificates were issued.

It is felt that the number of reinspections and reversals where inconsistencies have been found has a very salutary influence upon inspectors at shipping point. Supervisors report that the threat of reinspections is the strongest weapon in their hands to aid in obtaining thorough work. The number of reinspections, therefore, is not believed to be injurious to the service, nor is it higher than is to be expected in such a volume of work.

#### INSPECTION ENCOURAGES BETTER GRADING

Great progress has been made during the four years that the shipping point inspection service has been in operation in securing the adoption of recognized standards for fruits and vegetables. Supervising inspectors have reported better knowledge on the part of shippers of established standards and more effort to comply with the best grading practices. Insistence by several organizations on the shipment of graded products only, has kept on the farms products of low quality which otherwise would have gone on the market in competition with the higher quality offered by the better growers and shippers. The inspection service has helped cooperative associations in dealing fairly with their members.

#### STANDARDIZATION WORK

Rapid progress has been made in the standardization of grades for fruits and vegetables during the fiscal year. Grades have now been recommended for 35 different commodities. The use of national grades for fruits and vegetables has been extended through their adoption as official standards by the States. Thirty States have now officially adopted one or more of the United States grades. In many cases the use of these grades is compulsory for those crops standardized under the provisions of the State law.

Research relating to standardization has been conducted for two purposes—(1) to obtain data on which to base grades for new commodities and (2) to obtain data necessary to the clarification of existing grade specifications. Grades were recommended for 9 additional products during the past year,

and revisions were made in the grades for 19 products.

In addition to the grades published, an extensive study of the grading of walnuts was made in connection with the California State Department of Agriculture and a tentative grade formulated which it is expected may be released for use during the next shipping season.

A similar study of the grading of comb and extracted honey was made in cooperation with the bee-culture laboratory of the Bureau of Entomology and grades for both types of honey will be recommended in the near future. Publications have been prepared from data obtained from surveys and research work covering the preparation of various commodities for market, economic problems involved in the marketing of various crops, methods employed by American fruit and produce auctions, and other phases of the marketing of fruits and vegetables.

#### IMPROVED METHODS PREVENT REJECTION OF SHIPMENTS

A three-year study of the extent and causes of the rejection by buyers in the various markets of Northwestern boxed apples purchased f. o. b. shipping point has been completed except for the final analysis of the data. A report on this subject will be available by September, 1926.

This study, based on an examination of the sales records of representative shippers, discloses the fact that during the last three years there has been a progressive reduction in the percentage of cars rejected by the buyers. The rejections totaled 15 per cent of the sales of 1922-23 but fell to 6 per cent in 1924-25. These reductions are in a large degree attributable to improved handling and selling practices.

#### STATISTICS OF POTATO INDUSTRY STUDIED

A statistical study of the commercial potato industry has been made which includes statistics on the distribution of the crop from 16 important areas of commercial production to various States and to 14 principal city markets. The extent of competition between the various districts is also shown by the volume of weekly car-lot shipments. This material has been prepared for a bulletin which presents a picture of the potato industry that should be valuable to growers



in adjusting production to market demand.

### SURVEY OF FRUIT TREES

One of the most difficult problems in adjusting agricultural production is involved in planting fruit trees. To put before producers of the country the facts regarding bearing and nonbearing trees, commercial varieties, competitive districts, price trends, and costs of production, several divisions of this bureau have cooperated with State agencies to make a survey of the commercial fresh peach industry of the United States. The fruit and vegetable division cooperated in this study and obtained data relating to distribution, prices, methods of sale, and selling costs. A preliminary report covering the various phases of this survey is available.

### STANDARD TRADING RULES RECOMMENDED

A plan for Federal cooperation with the fresh fruit and vegetable industry was formally submitted to members of the trade in December, 1925, for comments and suggestions. The plan proposed was that the department would promulgate standard trading rules for use in the fresh fruit and vegetable industry, that the Secretary of Agriculture would enter into an agreement with any car-lot handler of fresh fruits and vegetables whereby such handler would be governed by the rules, and that the Secretary of Agriculture would provide a board of arbitration for the consideration of disputes referred to it by the parties concerned, would publish the names and addresses of those who signed the agreement, and would furnish such parties a number and symbol which they might use on their business stationery. The proposed plan was published in Service and Regulatory Announcements No. 97.

The responses received by the department to the request for comments concerning the proposed agreement and standard trading rules showed very little opposition, and a great many favorable replies and comments were received. Certain dealers, however, appealed to Congress for legislation to prevent the operation of the plan. Hearings were held by the Senate Committee on Agriculture and Forestry, but no action was taken, and the Senate Committee advised the Secretary that it would not interfere with the plan. Certain interests, however, filed a bill of complaint in the Supreme Court of the District of Colum-

bia, asking that the Secretary of Agriculture be enjoined from making the rules effective. The court held that the plan was not a compulsory regulation and that any possible injury to the plaintiffs was indirect and remote and therefore dismissed the bill.

### ENFORCEMENT UNITED STATES STANDARD CONTAINER ACT

The provisions of the standard container act are carried out through educational work and conferences with manufacturers of containers and through the testing of samples submitted by manufacturers to determine whether or not they are standard. More than 2,500 samples were tested during the year, and the manufacturers notified as to what changes should be made in order to meet legal specifications.

Field trips have been made, conferences attended, and lectures given for the purpose of bringing about the use of uniform standards for containers which are not yet covered by legislation. Much progress has been made in the effort to eliminate irregular and deceptive types of containers. Bills were introduced during the last session of Congress which provided standards for hampers and baskets, but none reached final passage.

### COLLECTION AND DISTRIBUTION OF 1918 EXCESS WOOL PROFITS

Activity in the collection of 1918 excess wool profits has diminished during the past fiscal year as a result of the policy of the department not to press pending court cases until a Supreme Court decision shall have been obtained in the W. A. McFarland case as to the validity of the 1918 Government wool regulations and as to the meaning of the term "gross profits," as used in the regulations. The McFarland case presents the first opportunity of the Government to take an appeal to the higher courts, that case having been decided adversely to the Government in Baltimore, Md., in February, 1925. This case was argued before the Circuit Court of Appeals on January 20, 1926, but the decision of that court has not yet been rendered.

Collections of excess profits during the year amounted to \$1,797.16. Refunds amounting to \$2,090.04 were forwarded to woolgrowers. The total amount of excess profits made on wool in 1918 now stands at \$1,512,040.76; the amount collected to date \$756,519.42 and the amount distributed to growers \$451,231.60. There remain 32



cases to be disposed of, involving \$714,738.64.

## DIVISION OF LIVESTOCK, MEATS, AND WOOL

CHARLES V. WHALIN, *in charge*

The response on the part of the public to the livestock work of the bureau, has been most gratifying, but the demands for greater service have increased beyond its facilities and resources. To meet a part of these increased demands, the last Congress made appropriations to expand the livestock market news service so as to serve six additional markets. Notwithstanding that facilities for handling the meat-grading service have been enlarged recently it will be necessary to make still further provision for handling the increased demands from the trade.

The information service of this bureau is now accepted by producers and distributors as a part of the marketing machinery. Rapid adjustment of supply and demand forces is necessary to insure economic stability and this adjustment can be accomplished only through the rapid dissemination of accurate information. Production and demand can be balanced when producers and consumers are in immediate and constant touch with each other and can make their wants and needs immediately known.

### STANDARDIZATION WORK

#### LIVESTOCK

After extensive study, numerous conferences with the trade, and a thorough test in market reporting, grade descriptions for market classes and grades of slaughter, feeder, and stocker cattle were prepared for publication. Tentative grade standards for these classes were formulated and submitted in connection with the proposed standards for beef grades at public hearings held at Portland, Oreg., Chicago, and New York City. Progress was made also in drafting specifications for grades of calves and vealers and sheep and lambs.

Department Bulletin No. 1360, Market Classes and Grades of Livestock, was published. This contains a complete schedule of the market groups into which livestock is customarily sorted for purposes of trade. It also outlines in some detail a basis for grading livestock and the principles on which the system used by the division is founded.

Under authority of the Purnell Act and in cooperation with the Bureaus

of Animal Industry and Home Economics, and several of the State agricultural experiment stations, a study was begun, having for one of its objects the determination of what makes quality in beef. Approximately 1,000 cattle fed by the experiment stations were graded as feeders, later as slaughter cattle, afterward as carcasses of beef, and finally cooking tests were made and the cooked meat graded by experts. In connection with these experiments standard grading charts were devised by which it is possible to apply a mathematical weighting to each grade factor, thereby facilitating scoring and making more accurate grade comparisons. The results so far indicate a rather close correlation between the grade of the live animal and the grade of the carcass.

#### MEATS

After eight years' practical use in market reporting and three years' use as suggested standards in commercial transactions, the standards for grades of carcass beef were formally promulgated by the Secretary June 3 as official United States standards, effective July 1, 1926. These standards provide for seven grades each of steer and heifer beef, and six grades each of cow, stag, and bull beef. Attention also was given to the preparation of grade descriptions and specifications for other classes of meat.

#### WOOL

The establishment and promulgation, effective July 1, 1926, of official standards for grades of wool and wool tops based on the numerical system as used in the manufacturing branch of the wool industry was one of the outstanding accomplishments of the year.

The fact that wool is one of the important commodities entering into international trade makes it necessary to have standards which are acceptable to and recognized by trade interests in the leading producing and manufacturing countries. Leaders in the manufacturing branch of the industry in this country recognized this, and at their request in 1923 negotiations were begun with representatives of the British industry. After several conferences held in this country and in England, an agreement was reached on representative types of wool. The Bradford (England) Chamber of Commerce approved and indorsed the selection, thus giving them semiofficial recognition in England. Grades were

developed also for wool tops which correspond to those established for grease wool.

The standards were submitted to various branches of the industry at a public hearing on April 29, 1926, and generally approved and indorsed. The president of one of the leading organizations of worsted and woolen spinners stated in a public address that "the recent adoption of the United States wool grade standards by our growers and industries and those of Great Britain to the end of international standards is an accomplishment of the Department of Agriculture that should merit our utmost praise and backing. The wool grade standardization is an achievement that has been looked forward to for many years."

The numerical standards as finally developed are based on diameter of fiber only. Within the range from the finest grade, 80's, to the coarsest grade, 36's, are 12 gradations of diameter of fiber. The differences in diameter between adjacent grades are almost imperceptible to the inexperienced eye, yet the recognition of them is one of the important requisites in wool manufacture.

#### WOOL-SCOURING STUDIES

Wool-scouring studies have been continued and tests have been made of many samples submitted. Shrinkage of wool is a vital factor in determining its value, and effort is being made to develop reliable methods of determining amount of shrinkage.

#### METHODS AND PRACTICES OF MARKETING

Changing conditions, increased competition, and the necessity for greater efficiency in marketing and distribution have necessitated study of the advantages and disadvantages of different marketing methods and practices.

At the request of the Oregon Cattle and Horse Raisers' Association, study was given to a marketing plan, devised to bring about a more orderly movement of their livestock to market. Information was obtained on the efficiency of direct marketing of western feeder cattle from the viewpoint of eastern feeders. Farmers' Bulletin 1502, "Cooperative Livestock Shipping Associations," was published and a manuscript dealing with the handling and marketing of the California spring lamb crop was prepared, and manuscripts on various phases of the mar-

keting of livestock and meats were submitted for publication.

Marketing of hogs direct to packers has attracted much attention recently and because of the rather broad interest in the subject on the part of producers and distributors considerable time has been devoted to the study of all available information pertaining thereto. This material has been summarized and while it may not be published because of the confidential nature of some of the information it is expected to be of much value in connection with any future treatment of this subject.

The retail meat marketing study which was begun in July, 1924, was completed and the results summarized in a final report which has been sent to the printer. This study went into the various problems of retail-meat marketing, including methods, practices, costs, and consumer demand. Two preliminary reports of the study were given wide distribution and were met with active interest on the part of the dealers. The contacts established with retail dealers in connection with this study are proving very helpful in the development of the meat grade standardization program and in other studies which the bureau is making.

#### STATISTICAL RESEARCH

The compilation, analysis, and interpretation of statistics of market prices, supplies, receipts, movements, and demand as related to livestock, meats, and wool is being given more attention as the demand for economic information increases. The results of the statistical research were made available to the public in the form of a large volume of reports, press articles, addresses, summaries, and reviews, all of which served to give more complete information regarding the economic situation in the livestock, meats, and wool industries. The bureau's livestock outlook reports are based on the statistical studies made by this division and the division of crop and livestock estimates.

Assistance was rendered to the Packers and Stockyards Administration in the study of several marketing problems. These included the factors causing sharp daily fluctuations in hog prices during certain periods, the competitive relations between livestock markets, and the trend toward direct buying of hogs by packers.

Attention was given to the study of available material which could be



helpful in ascertaining the seasonal movement of beef cattle to market by grades. As part of this project an analysis was made of all data pertaining to New York's meat supply.

#### PUREBRED LIVESTOCK PRICE SURVEY

The purebred livestock price survey was extended to include a larger number of breeders so as to make the report more representative of actual price conditions. Printed schedules were sent to 35,000 breeders with the request that they report on the number of purebred animals sold at auction and private sales, according to breed, sex, and age. The last survey showed that conditions in the purebred industry were improving and that a better demand existed for breeding stock. The publication of price information based on a large percentage of the total transactions serves as a reliable guide to actual values of purebred stock and is an important factor in stabilizing the industry.

#### WOOL REPORTS

The quarterly wool stock report showing stocks of domestic and foreign wool by condition, class, and grade in the hands of dealers in the United States was continued as a regular feature of the division's service, being released jointly with the reports of the Department of Commerce on stocks of wool held by manufacturers.

Steps were taken to work out plans which would enable the International Institute of Agriculture at Rome to compile and release periodically statistics on wool stocks and consumption of wool. The bureau's wool specialist conferred with representatives of the wool industry in England, France, Belgium, Germany, and Italy and found that sentiment was in favor of the development of such a plan.

#### MARKET NEWS

The primary purpose of the market news service is to supply producers, distributors, and others with complete and accurate current information regarding supplies, demand, prices, and general developments in the various market centers.

As the service is now firmly established, no material change in its fundamental features was necessary during the year. Sixteen branch offices were maintained, and at the close of the year preliminary arrangements had been made for opening the six new offices, made possible by an increase in the appropriations at the last ses-

sion of Congress. These offices will be located at Buffalo, Cleveland, Pittsburgh, Cincinnati, Indianapolis, and St. Joseph, and they will enable the division to serve a large group which heretofore has been served only partially and indirectly.

Approximately 5,000,000 mimeographed reports were distributed during the year to subscribers in all parts of the United States and in a number of foreign countries. This represents a material increase over the distribution of such reports in the preceding year despite the fact that market reports broadcast by radio and disseminated by other agencies, and everything was done to keep the mailing lists at the minimum. The distribution of the daily wool market reports is now limited largely to the press, and to cooperative associations and other interests which give the reports distribution through their own publications.

An important news service feature developed during the year was the inauguration of a special mimeographed market report service for the trade at South St. Paul. It was designed primarily to keep the commission men advised of developments locally and at other markets in order that they might reply promptly and accurately to requests by telephone and telegraph for market information. Several of the offices prepared weekly mimeographed reports for distribution to country bankers.

With one exception all offices of the division furnished market reports to one or more radio stations for broadcasting. This radio service is very popular in all parts of the country. The installation of a leased wire drop at Hastings, Nebr., for the broadcasting of reports through the powerful radio station located there met with marked favor as this station serves a large livestock producing area.

All of the national press associations and some of those covering a more restricted territory utilized the regular and special reports of the division for their livestock, meats, and wool market reports.

In addition, increased use has been made of telephones, commercial telegraphs, bulletin boards, and other means of dissemination.

Of considerable importance to the sheep producers of the Pacific coast was the arrangement for reporting sales of California dressed lambs at the three eastern markets. These reports, though necessarily brief, enabled shippers on the west coast to



keep in close touch with conditions at Boston, New York, and Philadelphia and regulate their purchases and shipments of live lambs accordingly.

#### MEAT-GRADING SERVICE

Coincident with the promulgation of the beef grades, increased interest in the meat-grading service developed and from indications at the close of the fiscal year demands for the service will necessitate material expansion at an early date. The service has been available during the year at Boston, New York City, Philadelphia, Washington, Baltimore, Norfolk, Chicago, and San Francisco. Certifications for grade were made for the United States Shipping Board and for steamship lines and commercial concerns.

Rules and regulations covering the meat-grading service were promulgated April 24, to become effective July 1, 1926. These regulations are based on the experience of the division in grading meat and meat products for the United States Lines, its ship fleet, and several other steamship lines and large commercial concerns during the last three years.

Listed among the commercial concerns for whom grading was done are several large packers, numerous small packers, and one Canadian packer. The service has also been in demand by some of the more important railroad lines, particularly during the summer months, when shipments of fresh meats are likely to deteriorate in transit. The service has become a regular feature of many restaurants and recently hotels have made inquiries concerning it. Several large railroad companies have requested the service for their dining cars and station restaurants.

One of the leading livestock journals started a campaign recently having for its object the labeling of various grades of meat so the consumer could be certain of getting the quality of meats he desired. The main object of this campaign was to increase the consuming demand for better grades of beef and thereby improve the market for high-grade cattle.

#### LIVESTOCK DEMONSTRATIONS

Interest in standardization among livestock producers is very active. Livestock grading demonstrations have been held before gatherings of farmers, ranchers, and agricultural college students. Demonstrations and ad-

dressess were given before approximately 150 gatherings of farmers and business men representing an attendance of 15,000 people. The work was carried on in seven western range States and in Virginia and West Virginia. In this work practical demonstrations were made by grading promiscuous lots of cattle and sheep gathered on the farms and ranches. In each instance the demonstrator called attention to the points of excellence and deficiency in each animal, giving specific reasons for placing it in one grade rather than some other.

#### OPERATION OF CENTER MARKET

C. W. KITCHEN, *Superintendent*

The operation of Center Market, Washington, D. C., and the supervision of the general conduct of tenants have been carried on in accordance with the rules and regulations established by the Secretary under existing laws.

#### RESEARCH WORK

Studies of retail prices and margins were continued particularly for comparison with prices prevailing generally throughout the country and especially with similar institutions locally. The three refrigerated stands installed during 1925 were observed as to their efficiency of type and operation. The total of sales for the last year aggregated \$9,526,779.38 (exclusive of the farmers line and wholesale row), an increase of nearly \$500,000 over 1925.

The outstanding feature of the work during the past year has been the large amount of repairs and alterations made. Old and obsolete stands are being replaced as fast as possible with modern refrigerated equipment. Every economy consistent with satisfactory service has been exercised, and the regular employees of the market have been utilized in making alterations in so far as possible.

During the past year the United States Court of Claims had under consideration a petition of the Washington Market Co., setting forth claim for \$200,000 alleged "going concern" value of the buildings and improvements on Reservation No. 7 (Center Market). The Department of Justice filed a demurrer which was sustained by the Court of Claims. The Washington Market Co. then attempted to obtain a writ of certiorari from the Supreme Court of the United States but this was denied, thus ending the litigation with respect to the pur-

chase of this property by the Government.

### GRAIN DIVISION

H. J. BESLEY, *in charge*

The work in the field under general supervision from Washington was directed by general field headquarters, Chicago, and Pacific coast field headquarters, Portland, Oreg., through 5 division supervisors and 32 district offices of Federal grain supervision.

#### ADDITIONAL STANDARDS ISSUED

Official standards for shelled corn, wheat, oats, rye, and grain sorghums were in effect during the entire fiscal year. Official standards for feed oats and mixed feed oats became effective on September 1, 1925. In addition official standards for barley were promulgated on May 26, 1926, to become effective August 24, 1926.

#### MEMORANDUM OF AGREEMENT WITH GRAIN EXCHANGES

The standards for feed oats and mixed feed oats were designed to classify grain mixtures consisting principally of cultivated and wild oats with varying percentages of other grains. Considerable difficulty had been encountered by the department in administering the United States grain standards act, and also the food and drugs act, (1) because of the lack of definite official trading terms, and (2) the adulteration of such products by the addition of water to make weight, or of worthless foreign material.

With official standards in effect and licensed inspection and appeal service available, this bureau undertook the responsibility of administering in the field the regulatory features of not only the grain standards act but also the food and drugs act as it applies to grain. Meetings were held with representatives of 19 grain exchanges, boards of trade, and chambers of commerce, 1 national association and 1 shippers' organization at which these organizations were urged to take steps through control of their memberships to avoid infractions of the laws rather than to permit them to occur with resulting prosecution, involving expense to the defendants and the department. Each of the 21 organizations signed a memorandum of agreement, subscribing to the plan of correcting illegal practices by prevention rather than by prosecution.

#### BARLEY STANDARDS

The preparation and establishment of standards for barley presented a

difficult problem by reason of the difference in conditions obtaining in the Middle West as compared with the Pacific coast area. Public hearings were held at several of the important barley markets, at which producers, dealers, and all other branches of the industry were afforded opportunity to present their views. Following this, official standards were established, divided into classes on the basis of the section where grown. While these standards will not become effective officially until August 24, 1926, it is believed that they will work out satisfactorily to all parties interested.

#### CONFERENCE AT MONTREAL

A condition has existed at Montreal, Canada, under which grain of United States production moving in bond in foreign commerce through Montreal, was not inspected on the same basis as grain moving in foreign commerce through ports of the United States. This department took up the matter with the Department of State and a conference between inspection authorities of the United States Department of Agriculture and the Dominion Government of Canada was arranged, which was held at Montreal, March 31, 1926. It was agreed by the conferees that the standard on which United States grain is inspected and graded at Montreal en route through that port in bond to foreign countries, should be on the same basis as the standards used in the United States.

Following the conference the Canadian Government requested the United States Government to assist it through preparation of type samples in bringing about the use of same standards at Montreal as in ports of this country.

#### INSPECTION AND APPEAL SERVICE

On June 30, 1926, there were 127 regular inspection points and 24 additional designated points, and 452 licensed inspectors. It was necessary to take disciplinary action against five licensee on charges of misgrading grain or other violations.

A total of 42,350 appeals from the grades assigned by licensed inspectors were filed and 20,680 appeals were sustained. Fees amounting to \$41,872.67 from appeals which were not sustained were covered into the Treasury as miscellaneous receipts.

#### TYPE TRAYS DISTRIBUTED

Type trays illustrating classes, subclasses, and grading factors of corn,



wheat, and oats have been sent to additional agricultural institutions. One set has been sent to Germany. A special set of 11 trays was furnished for the department's exhibit at the Sesqui-centennial Exposition at Philadelphia, and a special set furnished to the Field Museum of Natural History at Chicago.

Various institutions which are teaching grain grading are requesting more information and assistance. Approximately 500 samples of the different grains have been sent out during the past year. Samples were furnished and assistance given to the International Grain and Hay Exposition.

#### PROGRESS IN STANDARDIZATION WORK

Flaxseed standardization investigations were continued and progress was made in the development of standards for this commodity.

Rice standardization investigations for the purpose of perfecting the United States grades for milled rice and for rough rice were continued and progress was made in the development of improved standards for these commodities. A detailed study of California rice and of the grading, handling, and marketing conditions is now being made in that section.

In cooperation with extension leaders in the Southern States rice-grading schools were conducted in the principal rice centers of Arkansas and Louisiana. At these schools rice-grading demonstrations were made and moving pictures and lantern-slide lectures pertaining to rice grading and to improved methods of handling rice were given. As a result of these schools and demonstrations the Arkansas Cooperative Rice Growers' Association installed a complete rice-inspection laboratory and several rice mills installed new rice-testing equipment. Assistance was rendered to commercial rice inspection departments in the proper interpretation of the United States grades for both milled rice and rough rice.

#### SHELLING DEVICE PERFECTED

A mechanical device known commercially as the Smith shelling device for removing the hulls from samples of rough rice for testing and grading purposes was perfected. A public-service patent was granted to W. D. Smith, project leader in rice investigations. By use of this device it is now possible to determine the mill-

ing yields and qualities of rough rice and also to determine the percentage amounts of red rice and damaged and chalky kernels in rough rice, which makes uniform and accurate grading of rough rice possible. This device is now in regular use for commercial inspection purposes by one of the principal rice growers' cooperative associations.

#### MILLING TESTS OF RICE

Experiments were conducted to determine what effect commercial drying has on the milling quality of rice. These experiments demonstrated that when properly done commercial drying improves the rice for milling purposes, makes it possible to dry damp or wet rough rice in order to meet the commercial grades for milled rice, and prevents spoilage through heating in storage and transportation. A mimeographed report, "Handling, Grading, and Uses of Rice," was issued, and a number of articles and press stories on various phases of rice grading, handling, and marketing were published in the rice trade and farm journals.

#### TREATING OF SMUTTY WHEAT STUDIED

The prevalence in the 1926 crop of an unusually large quantity of smutty wheat in the hard-wheat belt of the Great Plains area led to certain treating and mixing practices among the terminal elevators which caused some serious grain-grading problems. To get reliable information on these practices, an investigation was made of the practices employed by terminal elevators and mills. Studies were made to determine the effect of the various kinds of treatment on the physical, chemical, milling, and baking characteristics of the wheat.

#### BAKING QUALITIES OF WHEAT TESTED

The milling, baking, and chemical results from 237 samples of wheat received from the principal grain markets of the country were compiled and studied. With respect to the relative baking qualities of the four principal bread-making classes of wheat, hard red spring ranked first, hard red winter a close second, white third, and soft red winter fourth.

A study was begun of the particular type or quality of flour best adapted to certain uses. Information of this kind is valuable in indicating to the plant breeder the desirable qualities toward which to breed, to the farmer in the selection of the proper seed, and



to the miller in the marketing of his product to the best advantage.

The effect on baking quality of various bread improvers used in commercial bread making were studied and the results were prepared in a report on the subject.

A study of the relation of kernel texture of wheat to its physical characteristics, milling and baking qualities, and chemical composition was completed and a manuscript giving the results of the study was prepared for publication as a department bulletin.

A study was made of the gross, net, and curvilinear correlations of protein content, kernel texture, and test weight per bushel of wheat to each of the milling and baking qualities.

Studies were made to determine the extent of weight losses occurring during the various steps in the process of making bread and in the baked loaf in order that a closer relationship may be established between laboratory and commercial baking practices. The results of this study were written up in report form.

A very large number of milling, baking, and chemical tests have been made in connection with a large number of scientific problems.

#### TEST FOR OIL CONTENT DEVELOPED

The method for making a quick determination of the oil content of flaxseed and linseed meal developed last year was further developed so as to make the test applicable for testing the oil content of peanuts, flaxseed screenings, cocoa, sesame, chocolate liquor, chip liquor, and cottonseed meal. The oil test was demonstrated at the tenth annual exposition of chemical industries held at New York City, where it created widespread interest and comment and resulted in the adoption of the test by several commercial organizations. A report describing the test was published in mimeographed form.

#### TECHNIC OF LABORATORY TESTS IMPROVED

Progress was made in simplifying the technic and methods for making moisture tests on rice and rice products. The Bidwell-Sterling method was found to be applicable for determining the moisture content of rice bran. Progress was made in developing a new type of retort for determining the moisture content of brewers' rice and screenings. Due to the demand of the milling industry for shorter methods for ascertaining the moisture content of flour, to effect more

efficient plant control, a new type of oven was tested and recommendations as to its use given out. As an aid to the Navy Department the proper temperature for operating the Brown-Duvel moisture tester for determining the moisture content of navy beans was determined. This was found to be 175° C. Department Bulletin No. 1375, "The Brown-Duvel Moisture Tester and How to Operate It," was issued.

#### GRAIN SMUT PREVENTION WORK

Assistance was given extension service of the department and the Northwest grain smut prevention committee in conducting a wheat smut control campaign in the spring wheat area of the Central Northwest. As a result of this campaign a very large proportion of the spring wheat farmers treated their seed wheat to prevent smut and this should result in a material saving of grain in the field and also a material saving in the market discounts in price for smutty wheat. During the previous crop year spring wheat farmers lost over \$5,000,000 through growing and marketing smutty wheat. Laboratory work has been carried on also covering the milling value of smutty and treated wheat.

#### WHEAT PROTEIN STUDIES

At the request of the Railroad and Warehouse Commission of the State of Minnesota, aid was given to the Minnesota State Grain Inspection Department in installing protein-testing laboratories at Minneapolis and Duluth. Frequent protein check tests were made for the Minnesota laboratories and aid was given to them in the matter of standardizing their tests solutions. Similar aid was given to other States and commercial interests.

A comprehensive study was made to determine the accuracy with which car lots of grain could be sampled for protein tests and it was found that over 95 per cent of the shipments and receipts tested could be sampled more than once and the results from a protein standpoint be duplicated within 0.25 per cent. Several hundred protein determinations were made for the office of cereal investigations to aid them in their wheat-breeding work.

This department has received requests from many sources, including a joint appeal from the governors of the States of North Dakota, South Dakota, Montana, and Minnesota, for a complete Federal service in testing

of wheat for protein content. Further legislative authority and additional funds will be necessary, however, before these requests can be met.

### **DIVISION OF DAIRY AND POULTRY PRODUCTS**

*ROY C. POTTS, in charge*

#### **DAIRY MARKETING INVESTIGATIONS**

A survey of the marketing problems confronting Oregon creameries was made, in cooperation with the Oregon Agricultural Experiment Station. The results of this study were published in Oregon Experiment Station Circular No. 74. In the report, the investigators pointed out that "the future success of Oregon's dairy industry depends upon united action within the industry in improving the quality of butter and the elimination of present evils existing in the purchase of raw material, also on group action in the marketing of the manufactured product." The formation of a creamery federation for the purpose of improving methods of manufacture, elimination of unfair and unsound practices in the purchase of cream and the sale of butter, was recommended.

#### **POULTRY AND EGG MARKETING INVESTIGATIONS**

A study of the methods and practices employed in marketing eggs in Texas was made, in cooperation with the agricultural extension service of the Texas Agricultural and Mechanical College. The study showed that the marketing facilities were not well developed and that the care and handling of eggs, both on the farm and in the channels of distribution, were not such as to insure delivery of a satisfactory quality product to consumers. Suggestions were offered for improvement of existing conditions.

In cooperation with the agricultural extension department of the Oklahoma Agricultural and Mechanical College, a three-months demonstration was undertaken at Tulsa, Okla., on the marketing of eggs on a quality or graded basis. Results of this study were published in a mimeographed circular, which "showed producers, as well as dealers, that when Oklahoma eggs are properly produced, handled, and marketed, a larger return can be obtained."

#### **COOPERATIVES ADOPT FEDERAL GRADES**

At the request of producers' cooperative egg marketing associations in

Ohio and Nebraska, assistance was rendered these associations in establishing grades for their market eggs. In each association the United States standards and grades for eggs were adopted. The results obtained indicate that the Federal grades are practical and especially well adapted for use by cooperative organizations in handling and marketing producers' eggs on a graded basis.

#### **EGG GRADES DEMONSTRATED**

The Federal grades for eggs were demonstrated in a number of States. In each State they were received with favor and accepted by the extension departments of the colleges as the basis for extension work in egg standardization.

#### **CHART OF STANDARDS AND GRADES FOR EGGS**

A chart was prepared, showing the seven standards of quality for individual eggs and various types of inedible eggs, and presenting the requirements of the standards of quality for individual eggs and for the buying, wholesale and retail grades. Each of the seven standards of quality for individual eggs and the various types of inedible eggs are lithographed in colors, reproducing the conditions observed in these eggs when viewed before the candle.

#### **INSPECTION SERVICES EXTENDED**

In cooperation with the Philadelphia Produce Exchange, an egg-inspection service was established on the Philadelphia market, the exchange officially adopting the service in lieu of an inspection service which it previously maintained. A Federal-State inspection service was established at San Francisco and Petaluma, Calif., in cooperation with the California State Department of Agriculture. The service in San Francisco was adopted as the official egg-inspection service of the San Francisco Mercantile Exchange. A Federal-State inspection service on eggs was also established in Missouri, in cooperation with the Missouri State Marketing Bureau.

#### **BOSTON TRADE OFFICIALLY ADOPT BUREAU BUTTER AND CHEESE INSPECTION SERVICE**

The butter and cheese inspection service maintained at Boston was adopted by the Boston Fruit and Produce Exchange as its official service.



**NEWS SERVICE REPORTS**

An outstanding development in connection with the market news service work on dairy and poultry products during the year was the adoption by the San Francisco Mercantile Exchange of the price reports issued by the bureau as the official price reports of the exchange. Coincident with the adoption of the price reports, the exchange also adopted the butter, cheese, and egg inspection service of the bureau as its official service.

The Boston butter prices as reported by this bureau were also adopted by the Vermont Creameries Association and the New England Milk Producers' Association as the official prices for the basis of contracts in marketing their dairy product.

**WISCONSIN CHEESE OFFICE MOVED TO PLYMOUTH**

The Wisconsin cheese office of the bureau, which had been maintained at Fond du Lac, was moved to Plymouth, as the latter city is a more important cheese market and it was found possible to maintain closer contacts with the cheese trade.

**DAIRY STATISTICAL WORK EXTENDED**

Arrangements were made with the bureau of dairying in Michigan, the department of agriculture in Minnesota, and the dairy and food department in Colorado for cooperation in compiling the quarterly report of dairy products manufactured in these States. The monthly statistical statement on the dairy situation was extended to include information on the monthly trade output of butter, cheese, and condensed milk and a monthly balance sheet statement for the entire dairy industry, expressed in terms of milk equivalent for each class of dairy products.

**COLD-STORAGE REPORTS**

WILLIAM BROXTON, *in charge*

The monthly cold-storage reports of various classes of food commodities such as fruits, dairy products and eggs, frozen dressed poultry, meats, and lard; and the report of livestock slaughter, costs, and yields have been continued. These reports are given publicity through the use of the leased-wire system and branch offices of the bureau and by other means. Information is gathered with respect to the cold-storage holdings of fish by variety,

and this information is furnished to the Bureau of Fisheries for release.

During the year a biennial survey of refrigerated warehouse space was made. Material was prepared for a statistical bulletin on cold-storage holdings and for use in the Department Yearbook. Special tabulations were furnished to the Port of New York Authority for use in economic studies, and special assistance was given to various State and municipal organizations for use in studying local food supply problems.

**DIVISION OF HAY, FEED, AND SEED**

W. A. WHEELER, *in charge*

**ADOPTION OF HAY STANDARDS BY STATES**

Seventeen States in which hay production or consumption is of importance had adopted United States hay standards as official State standards at the close of the year. Other important hay States are now giving serious consideration to the adoption of the standards.

In 39 States agricultural colleges are employing United States hay standards in the teaching of hay grading and field crops to students of agriculture. During the past year a number of State extension service leaders have conducted hay-grading demonstrations among the producers of hay, notably in Nebraska, Kansas, Alabama, Arizona, and New Mexico.

Educational and demonstrational work with reference to United States hay standards among State departments of agriculture, commercial exchanges, shippers' organizations, etc., has been given major attention the past year. Conferences have been held and demonstrations have been made at farmers' meetings and other gatherings.

**PRAIRIE HAY INVESTIGATIONS**

In cooperation with the Nebraska Agricultural Experiment Station, field studies are being made with respect to the distribution and identification of midland hay, upland hay, and grass hay in Nebraska. The chief objective sought is to provide additional knowledge about the classification for grading purposes of wild hay, also to determine practical methods for teaching inspectors to identify midland hay, upland hay, and grass hay when baled. Similar work is being done at Washington with hay from Colorado, Wyoming, and Washington.



### GRAIN-HAY INVESTIGATIONS

In cooperation with the Oregon Agricultural Experiment Station, preliminary field, market, and laboratory investigations were conducted in Oregon on grain hay and grain and vetch hay mixed.

### ALFALFA MEAL STANDARDS

The State departments of agriculture in Idaho, Utah, and Nevada are greatly interested in alfalfa meal inspection and most desirous of having the bureau formulate alfalfa meal standards and regulations governing the inspection methods. Preliminary studies were made on this problem, and cooperative plans are now being developed to organize research work on moisture and fiber analyses and other matters incidental to the formulation of standards.

### EFFECT OF TIME OF CUTTING ALFALFA ON GRADE

In cooperation with the Kansas Agricultural Experiment Station, experiments have been organized to determine the effect on the field stand of cutting alfalfa at various stages of maturity. Commencing with the 1926 crop year samples of alfalfa from each cutting made on the Kansas plots will be analyzed in the bureau laboratories to determine variations in the United States grade factors "per cent green color" and "per cent leafiness" arising from cutting at different stages of maturity. This work will provide facts of great value with respect to those production and farm-management practices that will produce alfalfa of a high commercial grade.

### INSPECTION SERVICE GROWS

Prior to this year the hay-inspection service has been limited by the fact that Federal standards were available only for timothy, clover, and grass hay. On July 1, 1925, standards were recommended for alfalfa and alfalfa mixed hay, prairie hay, Johnson and Johnson mixed hay, and mixed hay. On September 1, 1925, the Secretary of Agriculture made these recommended standards, together with those for timothy, clover, and grass hay, the official standards of the United States for the inspection and certification of such hays. The publication of these additional standards caused an immediate increase in the demand for Federal hay inspection, particularly in the Western and Southern States.

Seven schools for training hay inspectors were held at which prospective licensees were given practical training in grading hay. These schools were attended by representatives of State departments of agriculture, State agricultural colleges, the United States Army commercial organizations, producers' associations, and individual producers, shippers, and receivers. There were 72 Federal hay inspectors on July 1, 1926, compared to 35 on the same date in 1925.

Inspectors employed exclusively by this bureau have continued to assist other Government agencies by inspecting hay for them. The Federal Specifications Board adopted the Federal standards for timothy, clover, and grass hay some time ago as master specifications for all Government purchases, and in November, 1925, they adopted in a similar manner the standards for alfalfa hay, prairie hay, Johnson hay, and mixed hay. In January a conference was held at the hay standardization laboratory in Washington which was attended by representatives of nearly all Government departments interested in the purchase of hay. The standards were explained at this meeting and the various departments were offered the benefit of the inspection service. Considerable changes in methods of purchase were made in several of the departments as a result of this conference. This will result in financial saving to the Government and improvement in the quality of hay received on contracts.

Broomcorn inspection service was organized during the year in cooperation with the Oklahoma State Market Commission. Four broomcorn inspectors and one sampler were licensed at the close of this school to work in the State of Oklahoma. About 10 other dealers, producers, and employees of the State department attended the demonstrations held at the State capital in order to familiarize themselves with the broomcorn standards.

Organization of an inspection service for soy beans was begun during the year. This work is easily handled and has been successful from the beginning. Inspectors who are familiar with grading grain can learn quickly to apply the soy-beans standards and practically all necessary training can be conducted by correspondence and the exchange of graded samples by mail. Five inspectors were licensed in January, 1926, three in cooperation with the North Carolina Department of Agriculture and one each in coop-

eration with grain exchanges at Richmond, Va., and Chattanooga, Tenn. These inspectors have issued certificates of inspection for 57,923 bushels of soy beans.

#### GRAIN, HAY, AND FEED MARKET NEWS SERVICE

Further development of the grain, hay, and feed market news service was made during the year and its effectiveness was increased greatly. Demands for the information supplied by the service also increased materially, necessitating additional personnel in the Washington office and in the field offices at Chicago and Kansas City. Reports giving comprehensive reviews and analyses of developments in the grain, hay, and feed markets have been issued weekly throughout the year and numerous testimonials indicate that they have rendered an important service in providing an authentic and unbiased market news service for the agricultural interests of the country.

The feed market news service was improved and the scope of the work was broadened. Price, production, and stock figures were compiled to provide a more accurate statistical basis for the interpretation and analysis of market developments for the principal commercial feeds. Additional contacts were established in the principal feed markets from which reports on current market developments are forwarded regularly by telegraph or mail as often as required by the service.

The distribution of the feed-market information has been developed principally in cooperation with State marketing agencies, although special feed-market reviews are furnished weekly to several farm papers and to two important radio broadcasting stations. There is a growing demand for this feed-market information, particularly in important consuming territories, and an effort is being made to meet it as rapidly as facilities are available.

The grain and hay market news service has been made more effective by timely compilation of the market statistics necessary for the proper understanding and interpretation of the constantly changing conditions in the grain and hay markets. Contacts for the collection of market information have been extended so as to cover all of the important United States markets. Probably the most important reports received are those giving a summary of the week's developments in the grain and hay markets which

are forwarded from all markets by telegraph on Friday and used in the preparation of the weekly grain and hay market reviews issued each Saturday morning. At the close of the fiscal year more than 300 newspapers, with a total circulation of over 5,000,000, were publishing the reviews regularly.

#### TENTATIVE STANDARDS FOR BEANS ISSUED

A preliminary report on the standardization of beans was issued in August, 1925, in which is included the tentative United States standards for beans. Studies were made over a period of two years for the purpose of obtaining the essential facts relating to actual conditions of production, marketing practices, and consumers requirements in the dry edible bean industry as they relate to standardization.

Following the distribution of this report and the tentative standards, special effort was made to acquaint producers, dealers, and commercial consumers with the practical application of the standards. More intimate contact was established with canners, wholesale grocers, shippers, and producers. This was done through travel and an announcement that the bureau would analyze and grade in terms of the tentative United States standards without charge any sample of beans submitted by any one interested, which would give the sender a check on the quality of the sample and illustrate the application of the standards.

In response to this announcement 1,200 samples representing as many cars were submitted. These were analyzed and graded and the senders advised of the results. The bureau's findings on these samples were received favorably by the trade and in many cases were used as a basis for adjusting disputes as to quality.

#### SOY BEAN STANDARDS RECOMMENDED

United States standards for soy beans were issued in September, 1925, and recommended for use in the grading and marketing of this commodity for which no standards had been available. The application of these standards under a joint Federal-State inspection service in North Carolina proved their practicability and value.

#### STUDY OF SEED STOCK RECORDS MADE

The seed business is undergoing changes that have far-reaching effects. Years ago seedsmen paid little atten-



tion to any factors except color and size. About 15 years ago more interest began to be taken in purity and germination and a few States passed seed laws. It was not possible, however, by mechanical means to evaluate seeds readily from a purity or germination standpoint. A new interest in origin of seeds sprang up and during the last few years has overshadowed the interest in purity and germination with respect to certain kinds of seeds in particular sections of the country.

This bureau saw the necessity for a system of stock records that would preserve the identity of seeds from the time they leave the grower until they reach the ultimate consumer and thus afford a solution to the origin problem. It was found that many dealers were already keeping stock records.

A set of stock records, including in-tickets, dump or milling cards, invoices, shipping orders, etc., incorporating the best features of the 150 forms or more that have been collected will be prepared. It is hoped that the issuance of these forms will bring about greater uniformity and completeness in the records kept by seedsmen.

#### REPORTS ON VETCH SEED ISSUED

A new service on vetch seed to the growers in Oregon and Michigan and to consumers mainly in the Southern States was inaugurated. In recent years the demand for hairy vetch seed in Alabama, Georgia, and one of two other States has increased considerably. The reports on vetch seed issued by this bureau have tended to stimulate production in this country and at the same time keep prices of imported seed from soaring disproportionately.

#### SEED TRADE DEPENDENT UPON BUREAU'S REPORTS

With the discontinuance of the only commercial seed-reporting service during the year, the seed trade is dependent upon the bureau's seed service for comprehensive reports on prospective production, carry-over, movement, and prices of field seeds.

Information regarding carry-over, prospective production, prices, and demand for seeds in European countries is received by cable. This information supplements that received from regular correspondents in Europe and in this country, and is disseminated by mimeographed reports.

The three main kinds of reports issued during the summer and fall for

each of the important kinds of seeds were outlook, movement, and price, and shipment. In addition weekly seed reviews from January 20 to May 26, a prospective seed demand report on March 1, monthly retail seed prices for March, April, and May, and a retail seed sales summary on July 16, were issued.

#### ADMINISTRATION OF THE UNITED STATES WAREHOUSE ACT

H. S. YOHE, *in charge*

The warehouse act continues to play an important part in the marketing and financing of farm products. There was no phenomenal increase in licensed storage capacity for any one product such as the last several years witnessed, but the total licensed storage capacity for most of the products storable showed a normal increase. The largest increase for any commodity was for grain, due to the licensing of a number of large grain elevators, as well as a chain of elevators and warehouses operated by one warehouseman in Idaho. It is encouraging that as a general rule the desirable licensees who became licensed during the last five years or more continue to operate under the law and are stronger supporters of it than ever. The work under the warehouse act consists chiefly of licensing warehousemen, inspectors, graders and weighers, and supervising such licensees to see that they are meeting the requirements of the law.

#### SPECIAL SUPERVISION OF RECEIPTS

The plan which was inaugurated over two years ago to supervise more closely the printing of warehouse receipts for cotton warehousemen so as to guard against fraudulent issuance of warehouse receipts proved such a success that it was extended this year to all commodities with the exception of grain. Many of the grain warehousemen, however, have requested that their receipts be printed under the same supervision and on the same specially prepared paper. It has been exceedingly gratifying to note the various reports received from various warehousemen indicating that this supervision in the printing of receipts and the character of receipt which is issued under the plan have created a greater respect for the receipts. They are regarded very much like "paper money." Bankers are also enthusiastic about this new form of receipt, and it has already taken a distinct position as collateral in the credit field.



**AMENDMENTS TO REGULATIONS**

The cotton warehouse regulations were amended by increasing the inspection fees from \$1 per 1,000 bales licensed storage capacity to \$5 per 1,000 bales. This will increase the revenue to the Government without hardship on either the warehousemen or their patrons. An amendment to the sirup warehouse regulations provides for the storage of extracted honey under the terms of the Federal warehouse act. An amendment to the peanut warehouse regulations effective October 1, 1925, extending the period of storage from July 1 following the year in which the peanuts were harvested to the following March 31, resulted in a distinct service to the peanut growers, particularly to those who were marketing their crop through farmers' cooperative marketing associations, and to the banks loaning to these associations. That this action resulted in real service is apparent from the following taken from a letter received from the president of one of the largest growers' associations:

I am sure you will be pleased to know that we have at last disposed of the balance of the 1924 stock of peanuts and will soon be able to make final settlement for that crop. The fact that you so kindly extended the licenses of our warehouses in which the stock was stored, giving us time to dispose of it in an orderly manner, has enabled us to make a far better settlement than would have been possible under any other conditions.

**TOBACCO STANDARDIZATION WORK**

Work in developing standards for tobacco has been continued. A classification by types of all American-grown tobacco was made and published in pamphlet form as Miscellaneous Circular No. 55. This classification has met a distinct need not only of the producer but of the tobacco trade.

Under this departmental classification there are 29 distinct types of American tobacco. Grades have been prepared for all the leading types with the exception of Burley. Study was given to this type, however, and at an early date tentative grades for Burley tobacco will be issued.

A special report has been prepared on the sizing of tobacco. Charts are included to show how to divide a sizing board for determining lengths of tobacco. Lengths are expressed in both inches and centimeters. It is hoped this report may finally result in the use of a common sizing system for American-grown tobacco, not only in

the United States but in foreign countries.

**WAREHOUSING OF ADDITIONAL PRODUCTS**

During the last two years the department has received a number of requests to place canned fruits and vegetables on the eligible list for storage. Considerable study has been given to this subject and an effort is now being made to draft suitable regulations to govern the storage of such products under the law.

Organizations representing growers of various field seeds have indicated a desire to have such seeds placed on the eligible list. Much thought was given to these requests but because warehousemen were not able to make certain determinations which the law imposes upon them as positive duties, which determinations are essential to the giving of warehouse receipts collateral value, the department has abandoned the idea of placing seeds on the storable list at present.

At various times during the last five years requests have been received to license warehouses for the storage of cottonseed. During the past year requests were filed by various interests which indicated that a substantial use would be made of the law if cottonseed were declared eligible.

As a result, extended field investigations were made to determine the behavior of cottonseed while in storage, what elements tend to cause it to deteriorate, what the maximum moisture content might be for keeping purposes, what standards and grades may be in use, and to what extent bankers loan on cottonseed while in storage. These investigations developed some very interesting data which will be used as a basis for drafting regulations for the storage of this product. This information will be prepared for publication also as it will undoubtedly prove valuable to the farmers, buyers of cottonseed, warehousemen, and bankers.

**WORK ON THE PACIFIC COAST STRENGTHENED**

Prior to this year the work in Utah, Idaho, Nevada, California, Oregon, and Washington was conducted through a field office at Portland. On September 1, 1926, through cooperative agreements with State departments administering warehouse work, a field office was opened at Sacramento to handle the work in California and another at Boise for handling work

in Idaho and Utah. Through these three offices on the Pacific coast better service is given in this territory.

#### **BANKER SUPPORT OF THE WAREHOUSE ACT**

During the year a number of prominent bankers and various bankers' organizations have again lent their indorsement to the warehouse act and to receipts issued under its provisions. Numerous resolutions have been adopted which indorse the work under this act.

On June 10, 1926, the Washington Bankers' Association in the following resolution took action which should have a far-reaching influence:

*Be it resolved* by the bankers of Washington at Walla Walla in their thirty-first annual convention assembled:

That we commend all warehousemen in this State who are operating under the United States warehouse act and we urge upon warehousemen who are not doing so to qualify under the provisions of the act. We recommend that in the interest of agriculture in the Northwest and as a means of protection to farmers who store their products with public warehousemen that our members discriminate between applications for loans supported by warehouse receipts issued under the United States warehouse act and applications supported by other forms of receipts, and that we each counsel with our farmer and dealer clients with a view of educating them in the advantages of the Federal warehouse act.

#### **DIVISION OF AGRICULTURAL FINANCE**

NILS A. OLSEN, *in charge*

Major emphasis has been placed on farm credit and farm taxation during the past year.

#### **STUDIES OF RURAL CREDIT CONDITIONS**

In the credit work of the division attention has been given to regions confronted with special credit problems. A reconnaissance survey made of the range cattle industry in the northern Great Plains uncovered the fact that ranchmen were not making adequate returns, in part because they were operating on too small a scale. It developed that inadequate credit resources were an obstacle to the reorganization of the business. A study was therefore begun in Montana to ascertain the credit needs of ranchmen in that region and the ability of existing credit institutions to satisfactorily meet those needs. Though the study has not been completed the findings to date indicate that present credit facilities should be reinforced, perhaps by the introduction of agri-

cultural credit corporations through which to tap the resources of the Federal intermediate credit system.

Another study was made in Arkansas, where high costs characterized general credit conditions. In this study, which has been published as a bulletin of the Arkansas College of Agriculture, the volume and cost of credit used by farmers in various parts of the State and their relation to various types of farming were developed. Some light was also thrown on the factors affecting costs of farm loans in that State.

Still another credit study was launched in Oklahoma, with the purpose of ascertaining the relation between production credit and the development of cooperative marketing. This investigation has not reached the point where conclusions can be drawn, but it is expected that it will throw considerable light on the influence which conditions surrounding production credit have on the development of cooperatives.

A general survey dealing with agricultural credit corporations organized under the agricultural credits act was also initiated. The purpose of this study is to ascertain the factors which make for success and failure in this type of credit agency.

#### **STUDIES IN FARM TAXATION**

Cooperative studies of farm taxation problems in Missouri and North Dakota were completed and are now in process of publication. These studies analyze existing systems of taxation in those States and present the effects of these systems upon the farmer. Suggestions are made as to the kind of revisions in present laws which would tend toward a more equitable distribution of the farm tax burden.

In Texas a bulletin has been issued by the State agricultural college, based on a study of farm taxation conducted in cooperation with this division. This study, which presents a statistical analysis of increased taxation in recent years, is one of a series of projected studies covering farm taxation in Texas.

A study of State and local government revenues has been under way in Massachusetts during the year, and will soon be ready for distribution. Progress also has been made on cooperative studies in South Dakota, Oklahoma, and Colorado. The last two studies were inaugurated during the fiscal year.



The methods and immediate objectives of these studies necessarily have been varied, owing to the variation in conditions between States and to the lack of uniformity in the public records available for study. The purpose of the studies has been to discover how present methods of taxation lead to unduly heavy farm taxation. Where such conditions have been found suggestions have been made for revisions in existing laws which would be most likely to eliminate discriminations against agriculture.

The division has begun the preparation of a dependable annual estimate of the volume of farm taxes throughout the country, and has received the cooperation of county and town officials in almost every State. This study when completed will provide a current picture of farm tax burdens, together with considerable information as to reasons for recent changes in tax levels in various sections.

Further efforts have been made to develop new sources of information in farm taxation. On the basis of a suggestion made by the division, the Treasury publication "Statistics of Income, 1924" will contain a special tabulation of farm income reported on personal returns.

#### AGRICULTURAL INSURANCE

Research work in the field of agricultural insurance during the year has been considerably hampered owing to inadequate personnel, but statistical data on the business of farmers' mutual fire insurance companies during recent years were gathered. The study covers annual losses incurred by these companies in the various States, the expenses of operation, the amount of risks in force, the annual cost of insurance to members, and the relative importance of this movement as measured by the percentage of insurable farm property which is actually covered by this form of insurance protection.

Information and advice were extended through correspondence and personal interviews to the officers and managers of a number of farmers' insurance enterprises of various types.

Although insurance on the mutual, or cooperative, plan among farmers is most common and best established in the field of fire insurance, protection against loss by windstorm and by hail, as well as against death of livestock from various causes, is also provided in many sections of the country. A special study of livestock insurance has been started.

#### DIVISION OF STATISTICAL AND HISTORICAL RESEARCH

O. C. STINE, *in charge*

#### FOREIGN COMPETITION AND DEMAND

Foreign competition and demand must be taken into account both in planning production and in marketing farm products in the United States and abroad. In recent years approximately 13 per cent of the net product of the agriculture of the United States has been marketed in foreign countries. Considering only that part of the production that is sold off the farm, over 16 per cent has been sent to foreign countries.

Foreign markets are much more significant to producers of certain crops than to the United States as a whole. Approximately 50 per cent of the cotton crop must find annually a market abroad, facing increasing competition from Brazil, India, China, and new cotton-growing regions in both South America and Africa. Nearly one-third of the wheat crop of 1924 was sold in foreign markets. Producers of pork, tobacco, and apples, three other great industries, have to depend to a considerable extent upon foreign markets for an outlet. Prices received by farmers for all these products depend not only upon the production in foreign countries, but also upon foreign market requirements as to quality, quantity, and purchasing power of foreign consumers.

The producers of many farm products have to meet foreign competition in our own markets. The United States imported agricultural products, exclusive of forest products, valued at \$1,818,000,000 in the year ended June 30, 1925. More than one-half of these imports were in direct competition with American-grown products, for example: Sugar, \$294,000,000; wool and mohair, \$128,000,000; hides and skins, \$88,000,000; tobacco, \$78,000,000; dairy products, \$31,000,000, and flaxseed and flaxseed oil, \$33,000,000. The farmers who have to market their products against these imports are vitally concerned with production and prospects of production of these products in foreign countries as well as the foreign demand which is an important factor in determining at what price these products will be offered in the United States.

A well-balanced program of production and marketing requires up-to-the-minute knowledge of present and prospective supplies of all farm products and the demand for these products in



all available markets, giving the farmer currently a picture of the world situation.

#### WORLD CROP AND MARKET REPORTING SERVICE

This bureau is developing a world crop and market reporting service that is furnishing producers with timely and helpful information. With the assistance of the international institute, American consuls, commercial agents, and representatives of this department in Berlin, Vienna, and London, information is being collected as to production in all parts of the world and a beginning has been made in reporting market conditions in foreign countries.

The Berlin office has furnished the following reports:

Monthly economic report on economic conditions in Germany, Denmark, Holland, Poland, Norway, and Sweden, and developments affecting the market for agricultural products in those countries during the month, with special emphasis on cotton, pork, grain, and fruits.

A weekly pork and butter cable showing receipts and prices of hogs in Germany and prices of pork products and butter.

A monthly pork, fruit, and butter cable showing receipts and slaughtering of hogs in Germany, imports of pork products, detailed information on imports of apples, citrus fruits, and of dried fruits competitive with American products, and also imports of butter by chief countries of origin.

Special written and cabled reports dealing with the situation with regard to specific crops and with current economic and political developments affecting the market for our products.

The London office dispatches weekly cables covering barley prices, apple prices and condition of market, butter market condition, and condition of bacon market. Reports are cabled of wool auctions as they occur, of the almond crop in the Mediterranean region, and of important changes in British markets for agricultural products. The office keeps the department informed of important Government rulings affecting our products such as tariffs, quarantines, and other import restrictions and furnishes other information of agricultural interest.

Vienna is a strategic point for observing the progress of grain and fruit crops of the Danubian and Balkan countries. During the past summer

the office has effectively supplemented the official reports transmitted by the institute with special reports based upon observations and intimate local contacts. The Bosnian prune crop has been more frequently and accurately reported by the Vienna office than it ever has been possible to do through other agencies. The commercial apple crop of Czechoslovakia, Switzerland, and the Italian Tyrol has been adequately covered this season.

The Vienna office has cooperated with the Berlin office in reporting on Russian crop production, enabling this bureau to keep fairly well informed in the absence of official data. The office reports currently on conditions in the flour-milling and cotton-manufacturing industries and the bearing of these industries on the market for American raw products.

Direct cable exchange is maintained with the Governments of India, Norway, and Canada. Cable information from Argentina is received through the Argentine Embassy.

#### FOREIGN MARKET REPORTING

The reporting of foreign markets and marketing conditions and trends of prices have been continued and expanded. In addition to the reports forwarded by the bureau representatives a continuous flow of agricultural information is received from the consular offices, from foreign Governments, from the International Institute of Agriculture at Rome and from other sources.

For example, cables on wool prices for various grades, sales, clip, stocks, etc., are received from consuls at Melbourne, Montevideo, Uruguay, Buenos Aires, and Wellington, New Zealand; the consul stationed at Progreso, Yucatan, cables on the hemp situation near the first of each month; consuls in China and Japan cable reports on peanuts in January and November of each year; consuls in Spain and Egypt report on onion shipments to United States ports; and the consul in Sicily reports on lemons destined for the United States.

Wide publicity is given to the information obtained from foreign countries, through the leased-wire service, through various department publications, through the press, and through reports to interested persons on the mailing lists of the bureau.

A survey of European fruit markets has brought to the attention of producers and shippers in this country many ways in which the European market

requirements might be better met. Reports on these markets should result in avoiding much waste from shipping the fruit too green, not suitably packed for the ocean voyage, not put up in a manner to attract foreign buyers, varieties not suited to the market, sizes too large or too small, and in such great quantities as to overload weak markets.

The production of apples both in the countries in which apples are shipped from the United States and in other countries which produce for the same markets was studied and information is being furnished which may be helpful to fruit growers in this country in deciding what varieties and how much they should produce for the foreign market and what are the possibilities for expanding the market. Similar work on a smaller scale has been done for citrus producers.

#### TRANSPORTATION STUDIES

Economic material has been prepared for presentation to the Interstate Commerce Commission in freight rate cases. In this class of work material has been supplied in the fertilizer case involving the readjustment of the entire freight rate structure on fertilizer throughout the South; in the North Dakota grain case involving rates on grain from the Dakotas and Minnesota to Minneapolis and Duluth; and in the general freight rate investigation covering the investigation and possible increase in all rates applying in the territory west of the Mississippi River.

Studies have been made of the freight rates on specific agricultural commodities and rates on other commodities as they affect agriculture. This work includes a study of the comparative cost of the transportation of wheat from the various producing areas to the world market in Liverpool; a study of the historical development of rates on meat and livestock; a study of the rates and transit privileges on cotton; and a freight rate index on wheat showing the comparative level of rates now as compared with 1913.

#### ECONOMIC ANALYSIS

Statistical and historical analytical work was continued through the year along various lines. Indices of farm prices and exports of agricultural products were maintained. Estimates of agricultural income annually since 1919, were revised and brought up to date. A review and analysis of the

price situation for several agricultural products was made monthly throughout the year.

Attention has been given to the agricultural situation. A study has been made of agricultural income and the relation of fluctuation in business conditions to prices farmers received for what they produced and for income from agriculture. It was found that during the last five years fluctuation in farm income and farm prices have had a direct relation to changes in general business conditions and indicates clearly that the domestic demand for farm products is a very important factor in determining agricultural income.

Some progress was made in the study of the trend of foreign competition and demand in relation to the agricultural situation. Historically, experiments of foreign countries in attempts to control production, marketings, or prices of agricultural products have been studied to find the causes of success or failure and to learn what might be of interest or useful in dealing with the agricultural surplus situation in the United States. In cooperation with the Agricultural College of Montana, a historical study of the development of the cattle industry in eastern Montana is in progress.

Price analyses were continued along several lines. In cooperation with the cotton division, a study was made of cotton prices and a bulletin prepared dealing with factors which determine the price of cotton. In cooperation with the division of farm management, work was continued in analyzing the factors that determine the price of hogs and other livestock. Some progress has been made in analyzing the factors determining the prices of wheat and corn. The effect of the tariff upon the agricultural products has also received some attention. The object of all these studies is to assist the producers and handlers of agricultural products to understand better the economic law under which they operate and to make better adjustments in the production and marketing of agricultural products to meet consumers' demands and to obtain for themselves a fair return for their efforts.

#### DIVISION OF COOPERATIVE MARKETING

CHRIS L. CHRISTENSEN, *in charge*

#### COOPERATIVE MARKETING ACT PASSED

The cooperative marketing act, approved July 2, 1926, which provides



for the creation within the Bureau of Agricultural Economics of a division of cooperative marketing, has made possible a very material expansion of the work of the bureau in agricultural cooperation. While a certain amount of work has been carried on for a number of years, it is felt that agricultural cooperation should be studied systematically and comprehensively, and that businesslike assistance should be given to cooperatives in meeting their problems. Prior to the close of the fiscal year steps had been taken toward obtaining the services of a number of experts in cooperative marketing who will work with the various types of associations.

#### INCREASED ATTENTION TO COOPERATIVE MARKETING PROBLEMS

The outstanding development in agricultural cooperation during the year is the attention directed by the cooperatives toward increased business efficiency, to cooperation between organized groups, and to a consideration of the broader problems of marketing. Many large-scale organizations have passed the experimental stage and their business practices have become highly efficient. It is apparent, also, that many are considering the assumption of new functions, or an enlargement of their present functions.

The division's contacts with the problems of the cooperatives have been closer than ever before. It has been possible to present data which have been helpful in determining the policies of large cooperative groups. The service work has served the dual purpose of keeping the division in touch with the practical problems of organization, business management, finance and merchandising, and of informing cooperative associations of the assistance to be obtained from the bureau.

At the same time, because of its widespread contacts, the division is able to be of assistance in considering broader problems which concern whole regions and industries. The division renders valuable assistance to cooperative associations in arriving at unified policies in cooperative marketing, and in developing research work which will serve to guide the cooperatives in expanding their activities.

#### RESEARCH STUDIES

This division studies the marketing problems within cooperative business groups. Much of the work is concerned with the marketing of particu-

lar commodities, but studies of such functions as membership relations, financing and selling which have a general application are also undertaken. In addition, the problems of individual cooperatives are studied as a part of the project in cooperative business analysis.

#### COMMODITY MARKETING STUDIES

A general study of the cooperative marketing of cotton was completed, the results being published. This publication discusses the conditions leading up to the organization of the present, large-scale cotton marketing associations, and includes a description of their organization and marketing methods. The first edition of this bulletin was practically exhausted in a few weeks and a second edition was printed.

The relation of volume of business to operating costs and profits of cotton gins is brought out by a study of cotton gins in selected areas. This study was undertaken because of the growing interest in the possibilities of the local gin as a unit of the cotton-marketing associations. The results of an intensive study of the practices and costs of 74 gins in north-central Texas have been prepared for publication, and a manuscript, relating to the development, extent, and operation of cooperatively owned cotton gins is being prepared. Data have been taken from the records of about 80 cotton gins in southwestern Oklahoma, and in cooperation with the North Carolina State College of Agriculture and Engineering, a study was made of the costs and practices of about 75 cotton gins in that State.

One of the important problems in the cooperative marketing of spring wheat is the equitable payment to producers of premiums received for wheat of high protein content. A study of cooperative elevators operating in western Minnesota, North Dakota, and eastern Montana shows that variations in the protein content of wheat grown in the same community are sufficiently great to make an average of the station unreliable as a guide to the market value (from the standpoint of protein content) of wheat shipped by elevators at that point. In the same study, data were obtained regarding the hedging operations, storage practices, and costs of typical cooperative elevators in the area.

The problems of managers of fruit and vegetable cooperatives have been



analysed, and a bulletin prepared which discusses financing, accounting and pooling, and describes in detail the various agencies of distribution and the extent to which they may be used by fruit and vegetable associations.

The cooperative marketing of livestock has undergone material changes during the last three or four years. The development of cooperative commission agencies, the consolidation of country shipping associations into county or regional units, and the development of direct shipping and selling to packers by cooperative associations have created special problems. The division has undertaken studies of the organization, operating methods, and problems of cooperative livestock associations, including both the local shipping associations and the terminal cooperative commission firms. Schedules requesting detailed information have been sent to managers and directors of the various associations. The data thus collected will be analysed and the results published.

#### MEMBERSHIP PROBLEMS

In cooperation with the Kentucky Agricultural Experiment Station, a study has been made of the membership problems of centralized cooperative marketing associations, particularly the cooperative handling of cotton and tobacco. The objects of this study are: (1) To determine the fundamental facts responsible for the existence of such problems, (2) to analyse the methods and practices that are being used to meet these problems, and (3) to develop plans or suggestions for more effectively handling membership problems by educational methods.

#### COOPERATIVE BUSINESS ANALYSIS

A project dealing with organization, operating, financial, and selling problems of individual cooperatives has been developed. The need for this work is evidenced by the heavy demand which has been made by associations for studies of their special problems. During the year a study of the Staple Cotton Cooperative Association, Greenwood, Miss., was concluded, and a comprehensive report made to the board of directors. A study of the financial, operating, and merchandising problems of the Vermont Maple Products Cooperative Exchange, Essex Junction, Vt., was completed and a report made to the directors of the exchange. Late in the year a study of some phases of the sales policies of the California Fruit Growers' Ex-

change was begun at the request of the directors of the organization. The object of this study is to determine whether the policy of the California Fruit Growers' Exchange in acting as sales agent for the California Fruit Exchange, a cooperative organization handling deciduous fruit, affects the efficiency of the service which it renders its members. Preliminary work was begun in connection with a study of the poultry producers of central California which will be carried on during the coming year.

The object in conducting analyses of the business of individual associations is primarily to accumulate a sufficient number of cases to set up operating ratios and standards for cooperatives handling various commodities, and to study by a case system the economics of cooperative marketing. The development of methods that will enable the cooperatives to study their own problems is also a valuable service.

#### STATISTICS OF COOPERATION

Records of approximately 11,000 active cooperative organizations are available in the division files and contain, in the majority of instances, full information as to form of organization, management, membership, volume of business, financial status, and methods of marketing. With the help of this source library, the division is able to furnish cooperative organizations, as well as groups of unorganized producers, with reliable information regarding the possibilities and limitations of cooperation, which will enable them to organize and operate efficient and successful cooperative associations.

A large number of bulletins, reports, and bibliographies were issued during the year dealing with many phases of agricultural cooperation.

#### LEGAL PHASES OF COOPERATION

Department Bulletin No. 1106 entitled "Legal Phases of Cooperative Associations," is being enlarged and revised. Owing to the great increase in the number of cases involving cooperative associations which have been passed upon by the courts, an enlargement and revision of the bulletin is necessary in order to put interpretation of the law in available form.

#### COOPERATION WITH RESEARCH AND EDUCATIONAL AGENCIES

A study of the operation of cooperative elevators in North Dakota has been carried on in cooperation with

the North Dakota Agricultural College. A survey of cooperative organizations was completed during the year by the University of California in cooperation with the division. The division has cooperated with the University of Minnesota in a study of the possibility of forming a federation of farmers' elevators in that State. Cooperative projects with the University of Illinois and the University of Kansas in connection with research work in the cooperative marketing of grain were also undertaken.

Members of the bureau assisted in preparing the programs and took part in the proceedings of the first and second sessions of the American Institute of Cooperation, an educational institution the membership of which is made up largely of cooperative associations. Assistance was also given several State agricultural colleges in developing and conducting short courses for members and employees of cooperative associations.

#### EDUCATIONAL AND SERVICE ACTIVITIES

As part of the educational program of the division, the development of a series of motion pictures illustrating the cooperative marketing of important farm products has been continued. A series of glass and film-strip slides are being developed for the purpose of illustrating lectures on cooperative marketing.

Special assistance has been given to cooperative associations planning changes in their organization or methods and to groups of producers contemplating organization. Members of the division have worked with committees representing groups of cooperatives in considering such questions as membership relations, education, and management problems. In its service activities the division has attempted to bring to the cooperatives the results of research work and the services available in other divisions of the bureau.

Agricultural Cooperation, a mimeographed publication, has been improved in form and subject matter during the year. There is an increasing tendency among successful cooperative organizations to make public reports of their activities, and this publication furnishes a medium for disseminating current information of importance regarding the cooperative movement.

## DIVISION OF FARM POPULATION AND RURAL LIFE

C. J. GALPIN, *in charge*

This division comprises a very small working force in Washington, and a large number of cooperative employees located at State colleges and departments of agriculture throughout the United States who receive only a nominal salary from the Federal Government but who work in close cooperation with this department on problems connected with the farm population factor in their own States but which also have a national significance.

The various States are showing a marked interest in the study of their own population problems, and this bureau is making every effort to assist in this work and to help to coordinate the work of the various State and Federal agencies.

#### STATISTICS OF FARM POPULATION BY COUNTIES

The division has made demonstration tabulations of the farm population of several counties and has furnished these statistics to university laboratories for study and use in carrying out similar work. Attention has been called to the need of county statistics of farm population. Farm population statistics by States and by counties are now regarded as invaluable by many industrial firms and by the great railroads like the Great Northern, the Union Pacific, and the Southern Pacific.

#### THE MOVEMENT OF POPULATION FROM FARMS

An extensive inquiry has been made over the Nation, county by county, as to the movement of population to and from farms during the calendar year 1925. The results of this inquiry were tabulated and released during April, 1926. This report, as well as the two similar reports issued previously, have been in great demand. The year 1922 saw a net loss on farms of 460,000 persons. The net loss of persons from farms was 182,000 during 1924 and 479,000 during 1925.

#### THE FARMER'S STANDARD OF LIVING

This set of studies has engaged about half the energies and resources of the division during the current year in an effort to complete the first stage of a national study of this sub-



ject. The tabulation of 3,000 schedules obtained during the last two years has been completed and a bulletin, "The Farmer's Standard of Living" is in press. From the results of these tabulations, six preliminary reports on "living conditions and family living" in farm homes of selected localities of different States were issued. From the results of a more detailed tabulation of the data from four States, in cooperation with the Farmer's Wife and the Bureau of Home Economics, four additional preliminary reports on food, clothing, fuel and other household supplies, and furnishings and equipment were issued.

A second stage of study work will attempt to relate State by State the standard of living on farms in each State with the income of the farm families in that State, for the purpose of reaching national indices of both living and income. A subproject of analysis of standard of living data from farm management cost account records available from North Dakota and Minnesota is well under way.

### ECONOMICS LIBRARY

MARY G. LACY, *librarian*

The outstanding feature of the year's work in the economics library has been the inauguration of definite cooperation with the State agricultural college libraries in the compiling of bibliographies and indexes of common interest. An arrangement was recently consummated with Oklahoma by which an assistant from the library of the Oklahoma Agricultural and Mechanical College is to come to this library for an aggregate period of two months' work during the summer of 1926 to compile an index of official sources of the agricultural statistics of that State. Several other States are considering similar arrangements.

The demand for reference work for bureau workers has been constantly growing. In addition requests for bibliographies come in daily from other Government agencies, from institutions and individuals throughout the country, and from foreign countries. Fifty-two bibliographies and reading lists have been compiled during the year. The library is thus serving a wide range of agricultural interests. Letters of commendation are received continuously from agricultural leaders who make use of this library.

### DIVISION OF LAND ECONOMICS

L. C. GRAY, *in charge*

#### LAND RESOURCES AND UTILIZATION

The work during the year has consisted principally of (1) the study of the census returns on land utilization and preparation of a report showing regional changes in land utilization since 1920, (2) the preparation of maps and other material relating to the classification and utilization of land in the Great Plains region, (3) surveys of settlers' progress and land utilization in sample areas of the southern Great Plains, (4) the completion of a statistical study of the trend of yield per acre of the crops in the United States, (5) preparation of a manuscript dealing with the agricultural utilization of land in the cut-over portion of the Great Lakes States, (6) studies of the trend of consumption of agricultural products in relation to the probable future need for crop land, and (7) editorial revision and submission for publication of the temperature section of the Atlas of American Agriculture prepared by the Weather Bureau.

The 1925 Census of Agriculture secured statistics for the first time relating to land utilization. These statistics have been compiled by regions and a study is being made of the relation of crop, pasture, and forest land to the climatic, soil, and economic conditions.

Maps showing the classification of the land in the Great Plains region have been completed during the year by the land classification board of the Geological Survey, which has been co-operating with this department in the study of the Great Plains region. These maps with accompanying text, in conjunction with climatic maps and text completed in cooperation with the Weather Bureau, soil maps under preparation by the Bureau of Soils, and vegetation and carrying capacity maps and text being prepared in cooperation with the Bureau of Plant Industry and the Forest Service, are nearly ready for publication.

Maps showing the utilization of the land in the northern plains region, based on the tabulation of the census returns on land utilization for 1920 by enumeration districts, have been completed during the year and will be issued in a bulletin dealing with the problems of land utilization in this



region. Similar maps have been completed also for the Great Lakes States.

#### LAND RECLAMATION

Field studies to determine the economic limits of the cost of water for irrigation, begun in the preceding year, were completed in this fiscal year. Ten preliminary reports of the studies of the several projects covered have been issued.

Field work on a study of the extent to which land in drainage enterprises has been brought into cultivation and is producing the means of meeting the obligations undertaken to cover cost of its reclamation has been begun in cooperation with the Bureau of Public Roads.

#### LAND SETTLEMENT

An important phase of this work deals with methods used by States and private individuals and agencies in inducing settlement on lands that have not been used for agriculture. A bulletin has been submitted for publication entitled "State Policies in Selling and Settling Vacant Lands." Studies have been made of the methods used by private land settlement agencies in classifying the land offered for sale. This work also has for its purpose the development of methods that will promote definite policies of utilization for lands now unused or misused.

#### LAND TENURE

The agricultural census for 1925 has afforded an especially good opportunity to study the changes since 1920. In order to supplement census data, however, questionnaires on the changes in occupancy of farms were sent out both in 1925 and 1926. A preliminary report on change in occupancy of farms, 1924 to 1925, was issued. Field studies were carried on during the year.

The results of a study of white farmers in Gwinnett County, Ga., will soon be ready for publication. This was undertaken to provide a picture of the economic status and tenure and financial progress of white croppers, tenants, and small owner cotton farmers, who are so numerous in the Piedmont section of Georgia and in adjacent States. It is now planned to make this a part of a more comprehensive study of white croppers and white tenants in the Cotton Belt.

At the request of the extension service of the College of Agriculture in Maryland, a preliminary survey of the landlord-tenant relationships in Kent and Queen Annes Counties have been made.

The study of income as it affects land tenure has been started as well as a study of the effects of the landlord's lien. A study of large-scale farming in the United States based on census schedules for farms exceeding 1,000 acres in size was begun and is now well under way.

#### LAND APPRAISAL AND LAND VALUES

Studies of the effects of various local factors influencing farm land values have been continued in cooperation with the Bureau of Public Roads with the object of developing methods of appraising land values as a guide to purchase and sale, assessment for taxation, and credit policies.

Preliminary analysis of long-time records of land prices from county sales records and other sources is nearing completion. In these studies an attempt is made to measure the influence of various factors in the trend of such prices in selected farming areas. A preliminary report on the changes in farm real estate values as shown by the 1925 agricultural census was made.

Current collection of new data on the turnover in farms classified by type of transfer was undertaken, together with improvement of existing sources of current land value and land income data, with the object of issuing an annual report on the farm land situation.

A study of the effect of various local factors on, and of the relation of income to, land values in the cut-over counties of the three Lake States is in progress in cooperation with the Minnesota Agricultural Experiment Station.

#### FARM LABOR

A questionnaire calling for information concerning the nature and value of perquisites and allowances given to noncasual hired farm labor was sent out and the data thus obtained are being tabulated.

Studies now in progress include (1) monthly variation of amounts of family and hired labor on farms, (2) a statistical tabulation showing proportion of farm population engaged as hired labor and the relation between the agriculturally employed population and area of land and value of farm property by census enumeration districts, (3) the agencies of distribution of farm labor in 12 Northeastern States, farm labor supply and demand, farmers' methods of handling labor, and general farm labor conditions in those States, and (4) expenditures for

farm labor and the part of production that goes to meet labor expense.

## **DIVISION OF ECONOMIC INFORMATION**

J. CLYDE MARQUIS, *in charge*

The work of this division, which consists primarily of services to facilitate the distribution of the results of lines of bureau work, has grown steadily during the year. This is the result of the rapidly increasing use of market news and other economic information by producers, the trade, and industrial agencies. This increasing demand has necessitated the preparation of our material in a wider variety of forms to meet the requirements of specific groups. The tendency is definitely toward more specialization in forms of publication to avoid duplication and waste and to bring each class of information promptly to the class of people who wish it.

There has been an increased call from agricultural trade organizations. For example, representatives of the American Dairy Federation met with the bureau to study its work. This has resulted in a greatly increased call for various kinds of information necessitating the preparation of special mimeographs and releases. Several other organizations have developed similar contacts with the bureau.

Use of market news economic information by extension workers continues to grow rapidly. More than a dozen States now have well-organized economic services in connection with their extension work to which the bureau supplies a large volume of fundamental information. The demand from the news press, farm papers, farm organizations, and radio broadcasting has likewise called for more special preparation.

The material bearing on agricultural economics for an extension workers' handbook has been completed and that project will probably necessitate annual attention. The economic chart service has been continued with growing demand for charts made by the bureau.

### **SERVICE TO THE PRESS**

The distribution of bureau information through general press releases has been conducted along conservative lines in conformity to the general department policy to hold releases to short form, yet the work of the year has produced over 300 releases ranging from 100 to 1,000 words in length for general distribution.

Closer relations have been developed with Washington correspondents and representatives of trade journals and other papers so that a large volume of information concerning bureau work has been handled as special stories to these representatives. Several of the trade papers maintain representatives who visit the bureau daily to collect material. One daily business journal maintains a special reporter in the Department of Agriculture. The news associations have also maintained much closer contacts with the bureau than formerly, thereby facilitating the release of much material.

The regular press reviews, which include weekly reviews of grain, hay, livestock, fruits and vegetables, dairy products, etc., have been distributed to an increasing list. The daily marketgram which is sent over the leased wire and distributed to country weeklies now reaches a total circulation of several million.

The preparation of special articles for magazines and newspapers has been expanded by encouragement of technical workers in all lines to prepare such articles whenever possible.

The editors have read critically over a hundred such special articles prepared by members of the staff for publication in general, economic trade, and textile journals. Of these, 26 were written by the bureau editor.

### **RADIO NEWS SERVICE**

Services through the various offices of the bureau to radio broadcasting stations have been maintained and expanded in spite of the fact that radio broadcasting has been in an unstable state. The outstanding extension of the radio market news service of the year was the extension of our leased wire at Hastings, Nebr., where the large station, KFKX, was made available. This station has great power and has distributed our information from the Great Plains States into many areas not heretofore reached by radio.

Congress provided for extensions of leased wire through the agricultural college at Ames, where reports are broadcasted by the college station, and a drop has been opened at Oklahoma City where, through cooperation with the State board of agriculture, our reports are broadcasted for the Southwest. With the development of more college and university radio stations contacts have been made for the use of market material, and such information is now being used by sta-



tions at Ohio State University, Columbus; Purdue University, Lafayette, Ind.; and the South Dakota station at Brookings.

### ECONOMIC PUBLICATIONS

Contributions to the regular bulletin series of the department have included 45 manuscripts published during the fiscal year. About 50 other manuscripts are either in press or receiving editorial attention. This represents an increase in publications of about 25 per cent over last year. Some of the new publications are statistical bulletins and carry matter of historical value not heretofore available to the public. When once this series is completed, only new data will be issued from year to year.

As preliminary reports, issued in mimeographed form, the bureau has prepared and distributed 46 reports during the year in addition to many special reports. This method of publication which greatly expedites distribution of information has proved exceedingly popular with extension workers and others who wish early information on the results of research.

### ECONOMIC PERIODICALS

The regular economic publications of the bureau have been continued without radical change. "Crops and Markets" and the "Monthly Supplement" have been expanded slightly as the volume of statistics has increased. The weekly now has an edition of about 17,000, while the monthly supplement goes to a list of 125,000. The monthly economic review, "The Agricultural Situation," has been expanded slightly and continued in mimeographed form. "Agricultural Cooperation," the semi-monthly review activities in this field, has been improved by the addition of more charts and plates. "State and Federal Marketing Activities" in its expanded form has proved to be very useful to economic workers in the States and now comprises the most complete review of work in this field available in a single periodical. "Foreign Crops and Markets" has expanded slightly in size because of the increased volume of information gathered by the foreign section.

### EXHIBITS AND DEMONSTRATIONS

The division has handled the preparation of three large exhibits this year and considerable material for smaller demonstrations. The principal exhibit activity was the designing and preparation of the bureau's part of the Government exhibit at the Sesqui-centennial Exposition in Philadelphia. All major lines of work of the bureau were represented in a manner which created much favorable comment at the exposition.

Earlier in the year the bureau prepared part of the displays shown at the National Dairy Show and the International Livestock Exposition. Representatives of the bureau assisted in the department exhibit work at some of the State fairs.

### MOTION PICTURES

Two new motion pictures have been completed. "The Magic In It," presents the story of the value of farm accounting and was made by the Division of Farm Management and Costs in cooperation with the extension service. "Cooperative Marketing of Eggs," showing the method of handling Pacific coast eggs, was completed by the Division of Cooperative Marketing.

### PUBLIC RELATIONS

A large part of the time the head of the division is occupied in conferences with visiting representatives of organizations, editors, writers, foreign visitors, and others seeking specific information. The call upon the bureau for information for members of Congress has increased because of the vigorous agitation of agricultural questions. Preparation of information in response to such calls has added materially to the duties of the information workers.

A beginning has been made on the project of correlating and systematizing the statistical materials issued by the bureau. Plans for a system of related publications, from the daily information running through the weekly, monthly, and annual summaries, have been made so that the material may be published in a form more readily usable. Attention has been directed to the simplifying of statistical forms to avoid duplication and to place facts in the most useful and effective form.







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Wednesday, December 15, (a m)

EXPERIMENT STATION FILE  
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## REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF ANIMAL INDUSTRY,  
Washington, D. C., August 30, 1926.

SIR: I have the honor to transmit herewith a report of the operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1926.

Respectfully,

J. R. MOHLER, *Chief of Bureau.*

HON. WILLIAM M. JARDINE,  
*Secretary of Agriculture.*

### ACTIVITIES OF SPECIAL PROMINENCE

A noteworthy betterment of conditions for the production of domestic animals occurred during the year covered by this report. There was excellent progress in the eradication and control of important animal diseases. Improvement of livestock by better breeding made further gains. Research and experimentation yielded many important discoveries. Regulatory work also showed general public compliance with the laws and regulations for protecting and otherwise benefiting the livestock industry.

### COUNTRY FREED OF FOOT-AND-MOUTH DISEASE

The United States again is entirely free from foot-and-mouth disease which appeared in 1924 and recurred in 1925. Though the outbreaks were confined within portions of two States—California and Texas—the presence of the disease in the country caused great anxiety and necessitated quarantine restrictions, the last of which were withdrawn June 10, 1926. The final suppression of the disease, especially in the rough, mountain ranges of California where wild deer as well as cattle were infected, removed one of the most serious dangers that had ever threatened our livestock industry.

Foot-and-mouth disease appeared in Mexico near the end of the fiscal year, thereby causing renewed vigilance but

no immediate danger. Public sentiment in the United States fortunately recognizes the necessity for the aggressive measures used during the outbreaks of 1924 and 1925, including slaughter and burial or burning of infected carcasses. With continued co-operation among livestock owners, county, State, and Federal officials, there is reason to be hopeful that the United States will maintain its freedom from this foreign plague.

### TUBERCULOSIS YIELDS TO ERADICATION METHODS

The very active nation-wide campaign to eradicate tuberculosis from livestock continued with gratifying results. During the year a large increase in county-wide testing of cattle occurred; 109 counties completed tuberculin testing of their cattle with results that permitted the bureau to list them as modified accredited areas. The year's work brings the total of such counties to 198. The large area thus virtually freed of bovine tuberculosis is convincing evidence that the task of eradicating the disease from the entire country is possible of accomplishment. The number of accredited herds also increased greatly.

A survey showing the extent of tuberculosis May 1, 1926, revealed that average infection among cattle was about 2.8 per cent compared with approximately 4 per cent a few years ago. The reduced percentage of infec-



tion not only indicates plainly the decline of the disease among cattle, but means also a decline in the menace to people, especially small children.

As in the past, the tuberculin testing is conducted by qualified and trained men in a manner that insures greatest results for the funds expended. Cattle tested during the year exceeded the number during the previous fiscal year by 24 per cent, yet demand for the work was greater than facilities for testing, as shown by about 4,000,000 cattle on the waiting list June 30, 1926.

#### MEAT INSPECTION OPERATES ON LARGE SCALE

The Federal meat-inspection service continued to conduct its operations on a large scale, there being a slight increase in the extent of the work over the fiscal year 1925. An increase occurred also in the inspected slaughter of all classes of animals except swine, the total number of all food animals inspected being more than 68 million head. Tuberculosis continued to be the principal cause for condemnations of cattle and swine, including both carcasses and parts.

The laboratories of the meat-inspection service made large numbers of analyses and examinations of meats and products, and contributed also to the improvement of various processes in curing and handling meats.

#### HOG-CHOLERA LOSSES

Losses caused by hog cholera continued at low ebb during the fiscal year 1926. With the present widespread information among swine owners concerning the preventive-serum treatment, the industry should be comparatively safe from serious losses if swine growers apply their information.

The last period of noteworthy prevalence was in 1913-14 and since that time there has been no periodic wave of the disease.

With the decrease in hog cholera, farmers gradually discontinued immunizing their herds, with the result that probably 80 per cent of the hogs in the country are susceptible. Under these conditions it may be expected that any outbreaks will result in unusually heavy losses before the disease will be completely controlled.

#### SYSTEMATIC DIPPING ERADICATES CATTLE TICKS

Eradication of cattle ticks in regions of the South where these parasites are still present continues to make prog-

ress. During the year cooperative activities resulted in the release of 18 counties and parts of 9 counties from the Federal quarantine.

An act of Congress during the year placed Texas or tick fever in the list of contagious, infectious, or communicable diseases of livestock. The act which created the Bureau of Animal Industry in 1884 provided "that the so-called splenetic or Texas fever shall not be considered a contagious, infectious, or communicable disease within the meaning \* \* \* of this act." The 1884 law antedated by approximately five years the bureau's scientific discovery that the cattle tick carries the disease. This explains the apparent inconsistency of the exemption. The repeal of the provision, though frequently recommended, was not favorably acted upon until the current fiscal year. The present law thus harmonizes the legal status of the work with established scientific facts.

#### CONTROL OF LIVESTOCK PARASITES

The fiscal year 1926 marks the conclusion of highly successful experiments with sheep and swine parasites in Northern and Central States and the beginning of similar work in the South. Parasites of livestock in Southern States cause serious damage to the industry and the new projects begun during the year are aimed at more effective parasite control. Investigations of sheep parasites conducted for nearly 12 years at Vienna, Va., will hereafter be continued at McNeill, Miss.

The project for controlling roundworms of swine by the system of sanitation conducted in McLean County, Ill., for the last seven years was discontinued there and transferred to Moultrie, Ga. As in the case of sheep work, the purpose was to investigate parasitic problems in the South and to determine whether the method of control that was so successful in Central States would be feasible in southern localities.

Experiments with parasites of cattle are to be conducted also, with headquarters at Jeanerette, La.

#### CONTINUED PROGRESS IN LIVESTOCK IMPROVEMENT

In its efforts for the systematic improvement of domestic animals the bureau continued its educational campaign for the extensive use of high-quality, purebred sires. During the year this activity resulted in 1,708 new participants who placed all their livestock breeding operations on a

strictly purebred-sire basis. A noteworthy achievement was the success of Union County, Ky., in disposing of all scrub and grade bulls, thereby being the first county in the United States to reach this goal.

Union County has a well-developed livestock industry. Its cattle are chiefly of the beef type and 145 bulls—all purebred—were in service at the end of the year. A large proportion of the other sires used besides bulls also are purebred.

As a matter of public interest, Union County's accomplishment appears to be due chiefly to a very strong local sentiment for livestock improvement. This was brought about by active county-agent work during the last five years, by the assistance of State livestock specialists, by local press articles, and by barn signs and other literature supplied by the bureau under the "Better Sires—Better Stock" plan.

Forty-two other counties in 10 States also made creditable progress in about the same time, each of these counties now having 100 or more livestock owners using purebred sires. In Vermont every county is participating in the better-sires work.

Records of the work continue to show that the use of purebred male animals results also in the rapid improvement of female stock. With well-bred livestock as a basis, good feeding and management yield their best results.

At the end of the year 16,896 persons, owning nearly 2,000,000 head of animals and poultry, were participating in better-livestock work. The bureau furnished posters, charts, exhibits, and similar material to State and county extension workers cooperating in this useful activity. Scrub-sire trials, conducted according to outlines supplied by the bureau, proved to be a specially effective means for ridding communities of inferior breeding animals and furthering the cause of better livestock.

#### COOPERATIVE MEAT INVESTIGATIONS

Preliminary plans made during the previous year for cooperative meat investigations have developed into important research, now in progress. Nineteen State experiment stations cooperated with the department in the first year's work and in addition representatives of livestock and meat industries have participated in the plans and in the conduct of the work. Progress includes the development of apparatus for making accurate meas-

urements and color tests which largely eliminate the variable factor of personal judgment. Results to date include large numbers of records, detailed descriptions of carcasses, and observations and tests of cuts of meat derived from those carcasses.

Investigations previously undertaken to determine the cause of the condition known as soft pork were continued, 13 State experiment stations cooperating in this work. Developments of the year show clearly that soy beans, as well as peanuts and other oily feeds grown in the South, are important factors in the production of soft pork. The experiments are leading to information that shows to what extent oil-bearing feeds can be used without necessarily producing soft carcasses.

#### OTHER RESEARCH WORK

Investigations in the chemical and physiological studies of meat and meat food products have furnished new knowledge concerning the nutritive value of proteins in animal tissues. The supplemental value of certain meat proteins for that of vegetables is especially of interest. The protein of beef, for instance, enhances to a remarkable degree the nutritive value of protein in wheat, bolted wheat flour, corn meal, oatmeal, and rice. That is, when consumed in combination with beef proteins, cereal proteins are much more efficient for promoting growth than when the latter are fed alone.

Other biological studies have revealed the mode of action of disinfectants. This work, which is highly technical, shows which chemical members of various series of compounds have the chief power of destroying bacteria. Several products studied proved to be of exceptionally high bactericidal power. Research of this kind has its practical uses in the treatment and eradication of diseases and in increasing the effectiveness of disinfection.

Numerous experiments in the breeding, feeding, and handling of livestock at the bureau's various experiment farms were continued. The results in many cases require detailed discussion for a clear understanding and their practical use by livestock owners. Interested persons may obtain such results in the various publications prepared by the investigators or on application to the bureau.

#### PERSONNEL

At the beginning of the fiscal year the bureau rolls contained the names



of 3,979 employees, including both the Washington and field forces. During the year 438 new appointments were made, 20 employees were transferred from other bureaus or departments and 32 former employees were reinstated. These appointments and changes resulted in 490 additions to bureau forces. In the same period 424 employees were separated from the service, 170 by resignation, 29 by death, 14 by transfer to other bureaus or departments, 6 by removal for cause, 8 by retirement, while other separations numbered 197. At the close of the fiscal year the bureau rolls contained 4,045 names, a net increase of 66 employees over the preceding year.

The increase in bureau personnel during the year was made up largely of temporary employees assigned to tick-eradication work in the South and by a slight strengthening of veterinary forces assigned to meat-inspection work.

#### VETERINARY EDUCATION

The status of veterinary education has an important bearing on the training of future employees for veterinary positions in the bureau. At the close of the fiscal year the number of accredited veterinary colleges whose graduates are eligible to compete in civil-service examinations for bureau appointments was 13, the same number reported at the end of the last fiscal year.

The number of foreign veterinary colleges accredited by the bureau remains at 10. In accordance with an agreement between the bureau and the Civil Service Commission, restrictions against graduates of the Ontario Veterinary College of certain years, as shown in B. A. I. Circular 128, revised, page 10, were raised. All graduates of that college, if otherwise qualified, are now eligible to participate in civil-service examinations for bureau positions.

Freshmen enrolled in all accredited veterinary colleges in the United States and the one in Canada for the school year 1925-26, as reported to the bureau, numbered 165, an increase of 2 freshmen students over the preceding year. Total student enrollment was 582, an increase of 8 over the previous year. The number of veterinarians who graduated from the various accredited colleges during the last fiscal year was 132, or 11 less than the corresponding number during 1925. The figures showing present student enrollment in veterinary col-

leges indicate a slight gain in the attractiveness of the veterinary profession for young men.

#### LITERATURE, EXHIBITS, AND PICTORIAL MATTER

Publications prepared by the bureau during the year included 139 new and revised documents. Contributions to the various series of publications included 61 Farmers' Bulletins, 8 Department Bulletins, 2 Department Circulars, 4 Miscellaneous Circulars, 2 Yearbook papers, 16 contributions for the Journal of Agricultural Research, 8 posters, 13 issues of Service and Regulatory Announcements (including index), and 25 orders and amendments of a regulatory character. The bureau also approved for publication in scientific, agricultural, and other periodicals 45 manuscripts prepared by its employees.

These literary activities show a material increase compared with the preceding year. The bureau also furnished the press service of the department with numerous articles, news items, reports, and illustrations for distribution to interested newspapers and magazines. During the winter and spring months the bureau furnished extensive contributions of livestock and poultry material for broadcasting in accordance with arrangements by the department's radio office.

In cooperation with the Office of Exhibits of the department, bureau specialists designed and prepared exhibits and displays for approximately 50 fairs and expositions. Among the more important were the International Livestock Exposition, Chicago, Ill.; Tuberculosis Eradication Congress, Providence, R. I.; the American Health Congress, Atlantic City, N. J.; Restaurateurs' Convention, Washington, D. C.; and the Sesqui-centennial Exposition, Philadelphia, Pa. It is estimated that about 3,000,000 persons observed the bureau exhibits shown.

Besides the larger displays, 12 small folding exhibits were prepared for county fairs, conventions, and similar gatherings, the purpose being to make available a class of exhibits which can be shipped economically by express and that will be seen by persons who do not attend the larger fairs and shows. Field workers of the bureau likewise requested many maps, charts, lantern slides, and special displays, which were furnished from available stocks or were prepared especially for the purpose.



The literary and exhibit activities of bureau employees have resulted in a gradually increasing public understanding of the bureau's varied activities and have been helpful in establishing and maintaining excellent cooperation with industries, organizations, and individuals who come in contact with the bureau's official work and its field employees.

### ANIMAL HUSBANDRY DIVISION

The work of the Animal Husbandry Division, consisting chiefly of research in animal husbandry, including poultry husbandry, was conducted under the direction of E. W. Sheets, chief.

#### MEAT INVESTIGATIONS

Important research was undertaken during the year in connection with the nation-wide study of the factors which influence the quality and palatability of meat. This project was organized on a cooperative basis, with a number of the State agricultural experiment stations, the Bureau of Animal Industry, and other agencies participating. The widespread interest in the project is shown by the fact that 19 States took part in the year's work.

Cattle and beef were given most attention at the beginning of this study. It was soon apparent that the development of accurate measurements for determining and expressing the quality in meat, other than by personal judgment, was a prime necessity in this investigation, in order that results obtained at different stations could be compared. Progress was made in this primary phase of the investigation.

Early in the year a grading committee was appointed, composed of one representative of the cooperating State experiment stations, one from the Bureau of Animal Industry, and one from the Bureau of Agricultural Economics. The work of this committee was to score and grade the feeder cattle, slaughter cattle, and beef carcasses in the experiments conducted by the various stations. Approximately 1,000 cattle and carcasses were so studied. A mass of valuable data was obtained which furnishes an opportunity for establishing relationships between quality in the feeder and slaughter animal and quality of meat as observed in the carcass.

Numerous factors, including sex, age, breeding, grade, and grass versus grain feeding, each under varying conditions, were studied in the first year's experiments. In most of the experi-

ments the two prime-rib cuts from one representative carcass in each lot were taken for laboratory studies. Ribs from 63 cattle were so taken and sent to the Animal Husbandry Division at Washington.

Slaughter records were kept of all steers handled in the commercial packing houses. When it was possible to slaughter in a college or the Government abattoir, more complete records were kept, to include weight of all organs, both full and empty, length of intestines, etc. Yields of chilled carcasses and of wholesale cuts were included when possible.

Ribs from the left side were roasted by the Bureau of Home Economics and graded by a committee as to tenderness, flavor, and juiciness. The corresponding ribs from the right side were boned out into "eye" muscle, visible lean, visible fat, and bone. These were then analyzed chemically for fat, protein, ash, and water. A specially constructed color tester determined the color of the lean at various times after the exposure of meat to the air. Microscopic examination was made of each rib to determine the histological structure of the meat, and several devices were used to record the tenderness or breaking strength of the muscle fibers. Other ribs were cut into steaks, paired by contrast of quality according to the laboratory findings, and tested by selected consumers to check the mathematical comparison.

The laboratory study of samples from only one carcass per lot is considered insufficient and the work of the past year is regarded to a considerable extent as preliminary.

Studies of factors which influence the quality and palatability of lamb meat were also begun by the use of 350 lambs.

### ANIMAL HUSBANDRY EXTENSION

Cooperation with the department's Office of Cooperative Extension Work and State agricultural colleges carried on under the provisions of the Smith-Lever Act was continued, with a view to getting information on animal husbandry subjects before the public extension agencies and into the practices of farmers. The division's activities in this project consisted in reviewing the plans for animal husbandry extension work from the various States and making recommendations for improvement, preparing for the Office of Cooperative Extension Work a summary of results from reports of State animal husbandry extension specialists, assisting

in the preparation and utilization of literature, posters, lantern slides, motion pictures, and exhibits, attending conferences, and aiding the field work of the agents.

### ANIMAL NUTRITION

Investigations in the nutrition laboratory included analytical work on approximately 1,110 hogs, studies of the formation of fat in a hog fed brewers' rice—an approximately fat-free ration; determination of the composition of the fat in the blood, liver, and other parts of the animal fed on brewers' rice; the comparison of fat formation in different species of animals including beef, hogs, sheep, and poultry; and separation of the fatty acids obtained from hogs fed different types of feed.

Eleven calorimetric studies were made of the physical factors affecting hatchability of eggs, covering various degrees of humidity for a given rate of ventilation and temperature.

The studies of the protein requirements of chicks have required a series of experiments to eliminate variables other than proteins. The work on the protein requirements for laying hens is in its second year.

A limited number of analyses were made of the red and white muscles of chickens, which demonstrated a decided difference in the soluble proteins contained in these two kinds of muscle.

A collection of references for the bibliography on meat was completed and is being abstracted.

### ANIMAL GENETICS

The guinea-pig inbreeding experiment was continued with the five inbred lines used in the past. Two of these lines have reached the twenty-seventh generation of brother-sister mating. In connection with this phase of the work, a detailed analysis is being made of segregated lines within each of the families. It has been found that although certain characteristics tend to become fixed to a high degree in each family, segregations occur as late as the twentieth generation, giving rise to subfamilies which differ significantly from the rest of the family.

A case of this is the occurrence of a particular kind of abnormality, otocephaly, in which the head is imperfectly developed, and which has appeared in large numbers in the twentieth generation of one family. During the year extensive crosses

were made between this family and another which has not produced such abnormalities. The results prove, among other things, that the monstrosity is not determined entirely by genetic factors. An important result is the indication that the heredity of the dam does not determine otocephaly.

The swine-inbreeding project has made considerable progress. One line of Tamworths has reached the third generation of continuous brother-sister mating. Considerable increase in the number of first generation inbreds occurred during the year giving more chance for selection of breeding stock for the second generation. Segregation of certain traits occurred in certain first-generation litters. The most noticeable of these has been certain colors in the Poland-China and Tamworth breeds, but probably the most valuable trait to segregate has been type in the Chester-White breed. One litter of 11 first-generation pigs shows marked segregation of type.

### BEEF-CATTLE INVESTIGATIONS

Investigations in the production, wintering, and fattening of beef cattle were conducted in the Appalachian region, in the Corn Belt, in the Cotton Belt, and in the range areas of the West, Northwest, and Southwest, in cooperation with State experiment stations. The Bureau of Agricultural Economics, the Bureau of Plant Industry, and the Forest Service of the department cooperated in some of these studies.

### INVESTIGATIONS IN THE APPALACHIAN REGION

An experiment begun in December, 1922, at Lewisburg, W. Va., to study the growth of weanling calves, yearlings, and 2-year-old steers, fed various winter rations followed by summer grazing on blue-grass pasture has been completed. Ninety head of Texas range-bred steers purchased as calves in the fall of 1922 were marketed as 3-year-old grass-fat steers in September, 1925. The data have been prepared for publication.

An experiment was begun in December, 1925, to compare the economical wintering of two distinct market grades of steers and the effect of grain as a supplement to summer pasture on the quality of meat produced by both grades of steers.

A Milking Shorthorn herd was established during the year at the United States Morgan Horse Farm, Middlebury, Vt. The plan is to develop the



herd and study the merits of individual animals and of the breed.

Experiments were begun in southwest Virginia in September, 1925, to compare various methods of handling and fattening steers.

#### INVESTIGATIONS IN THE CORN BELT

An experiment to determine relative values of different methods of feeding beef calves previous to weaning time and from weaning time to yearlings was begun at the Sni-a-Bar Farms, Grain Valley, Mo., in May, 1925, and completed in June, 1926. Comparisons were made between calves allowed to run with their dams on grass without additional feed, calves with dams on grass and allowed grain fed within creeps, and calves kept on separate pasture from dams with access to grain and allowed to nurse twice daily.

The various lots of calves were fed similar rations of corn, linseed meal, and alfalfa hay from November 23 to June 4, and the effect of the method of handling previous to weaning time upon the feed-lot performance was determined. Mimeographed reports have been distributed. The experiment is to be continued.

#### INVESTIGATIONS IN THE COTTON BELT

A project begun in 1923 on 320 acres of cut-over, long-leaf pine land at McNeill, Miss., was continued to compare the effects of burning native pastures on the vegetation, the gains of cattle grazed on such pastures, and the reforestation which takes place. The work of improving the herd, begun in 1920 with native cows, is being continued. Twenty head of Hereford cows from the Iberia Livestock Experiment Farm have been added to the herd.

The cooperative project with the Arkansas Agricultural Experiment Station to compare the relation of feed consumed to the quantity and quality of meat produced by purebreds, grades with three-fourths and one-half pure blood, respectively, and scrubs, begun in June, 1924, at Jonesboro, Ark., has been continued.

At Jeanerette, La., an experiment comparing various rice by-products for fattening steers has been continued.

#### BEEF PRODUCTION ON THE RANGE

Investigations have been under way for four years in Texas and Colorado to determine the relative merits of various methods of producing range cattle. Progress reports have been issued each year.

Studies of different practices of beef production in the northwestern range area, in Montana, North Dakota, South Dakota, and Wyoming, begun in June, 1925, in cooperation with the respective State agricultural colleges, have been continued. Similar beef-cattle studies are progressing in the Southwest, including western Texas, New Mexico, Arizona, and southern Utah.

An experiment similar to that of previous years in wintering steers was carried on at Ardmore, S. Dak., to determine the effects of various methods of winter feeding on the gains made on pasture during the following grazing season. Sixty head of yearling steers divided into four lots were fed rations, respectively, of oat straw and alfalfa, alfalfa, silage and alfalfa, and wheat-grass hay. The results of this test have been included in the annual report of the Ardmore station.

The third and final year's work in calf fattening on home-grown feeds at the Big Spring, Tex., and Tucumcari, N. Mex., dry-land stations has been completed. Comparisons were made with sorghum fodder and sorghum silage, and cottonseed hulls as a source of roughage, and cowpea hay and cottonseed meal as a source of protein.

At the north Montana substation, Havre, Mont., a project begun in 1922 to develop a herd of beef Shorthorns possessing capacity for milk production, and wintering experiments begun in 1921 to compare native grass hays with alfalfa, corn fodder, and silage for cows, yearlings, and calves, are being continued.

A breeding herd of approximately 200 beef cattle is being maintained at the United States Range Livestock Experiment Station, Miles City, Mont. Range production problems are to be studied.

An experiment at Kingsville, Tex., begun in 1924, in which Brahman crosses were compared with Hereford and Shorthorn steers in feed-lot performance and in killing qualities was continued during the winter of 1925-26. A progress report covering the first year's work has been issued.

#### INVESTIGATIONS AT BELTSVILLE, MD.

A beef Shorthorn herd was established at the Animal Husbandry Farm, Beltsville, Md., in May, 1926, to be used as a basis for breeding and other experimental work.

#### BEEF-CATTLE INVESTIGATIONS CORRELATED WITH MEAT STUDIES

The projects dealing with the fattening of steers for market at Jeaner-



ette, La., Big Spring and Kingsville, Tex., Tucumcari, N. Mex., Grain Valley, Mo., Jonesboro, Ark., and Lewisburg, W. Va., have been linked with the national meat project—a study of the factors influencing the quality and palatability of meat. The steers at these places have been graded and samples of meat analyzed according to the method of procedure outlined in the meat project.

#### SWINE INVESTIGATIONS

Swine investigations were continued at the United States Experiment Farm, Beltsville, Md.; the Coastal Plain Experiment Station, McNeill, Miss.; the Iberia Livestock Experiment Farm, Jeanerette, La.; the Ardmore Field Station, Ardmore, S. Dak.; the Belle Fourche Experiment Station, Newell, S. Dak.; and the United States Range Livestock Experiment Farm, Miles City, Mont.

#### FEEDER PIGS

Comparison of costs in the production of feeder pigs and the relative advantage of selling pigs at feeder-pig weights and at market weights are being determined both for arid and irrigated localities at northwestern field stations. The comparative value of limited rations and full feed for growing pigs when alfalfa is plentiful is also being determined.

#### SOFT-PORK INVESTIGATIONS

The studies of the various questions associated with the soft-pork problem, begun in 1919, have been continued during the past year. As in preceding years, the major part of the work has been cooperative in character. Thirteen State experiment stations have worked with the bureau in conducting 22 experiments in which 670 hogs were used. In addition, 13 experiments involving 369 hogs were conducted at three department stations.

The influence of different feeds and feed combinations upon firmness has remained the principal line of study. Soy beans have increased in production and importance as a hog feed in the United States to such an extent that they now seem to demand primary consideration among the feeds regarded as softening. Consequently more attention was devoted to soy beans in these investigations during the year than to any other feed. Since soy beans are regarded mainly as a supplementary feed and in a majority of cases are fed with corn,

most of the experiments were conducted to study the influence of different combinations of these two feeds under various conditions.

The following conclusions were adopted by the cooperating agencies at the conference which was held at Chattanooga, Tenn., in April, 1926:

(1) Soy beans grazed with a supplementary ration of 1.5 to 2.5 per cent of shelled corn and with minerals self-fed to pigs starting at weights ranging from 25 to 85 pounds and making gains of approximately 40 to 75 pounds through a period of from 8 to 10 weeks produce, in the usual case, carcasses of a satisfactory degree of firmness when a subsequent gain in weight of 125 pounds or more has been made by the pigs on corn with tankage.

(2) Soy beans fed as a supplement to corn in dry lot in the ratio of 1 pound of soy beans to 3 pounds of shelled corn to pigs ranging up to 130 pounds in starting weights will not produce firm carcasses in the usual case when the hogs are slaughtered after a gain of approximately 100 pounds or more has been made on the corn-soy bean ration.

Studies of the influence of peanuts, rice polish, and rice bran, when followed by hardening feeds, have been continued. Corn, brewers' rice, sweet potatoes, and milo were included among the hardening feeds used. Investigation of the influence of alfalfa when used extensively in the ration was begun. The softness of hogs in some localities has been attributed to the use of cull navy beans in the ration. Work to study this question was started during the year. Brewers' rice has continued to receive attention not only for its unusual hardening quality but to determine the effects when used in the bred-sow ration and as the basal feed in growing and fattening pigs.

Certain factors other than feed are receiving careful consideration. Initial weight, or age as the indicator of initial weight, is now regarded as a variable which will produce variation in firmness in connection with some feeds. This factor was studied as a secondary object in a number of tests conducted. The relation between rate of gain and firmness is another question receiving consideration.

During the year a paper entitled "Formation of Fat in the Pig on a Ration Moderately Low in Fat" was published in the Journal of Biological Chemistry. The results reported in this publication explain the reason for the progressive hardening of hogs fed corn with nonsoftening supplements. In April, 1926, Department Bulletin 1407, entitled "Some Results of Soft-Pork Investigations," was issued. This gives a detailed presentation and discussion of the conclusive

results of the soft-pork investigations from July 1, 1919, to June 30, 1924.

#### INTERDIVISION COOPERATION

Cooperative studies with the Biochemic Division on the effects of treating sucking pigs with hog-cholera virus and protective serum are still in progress. The results of this work were reported at the annual meeting of the United States Livestock Sanitary Association, December, 1925. This report for the period 1921-1925 showed that the 1,715 pigs treated with serum and virus at various ages, between 24 hours and 9 to 10 weeks, suffered no arrest in their normal development. Neither was there a single case of vaccination break or cholera sickness resulting from the simultaneous treatment of 3,187 pigs with serum and virus. Satisfactory immunity was produced in all pigs tested for immunity except those treated during the spring and fall of 1924. The reason for failure to obtain immunity in the pigs treated in 1924 is still under investigation.

A total of 609 spring pigs were treated at the field stations in 1925 with uniform doses of serum and virus of identical lots without vaccination breaks except possibly two cases at Newell, S. Dak.

At the Beltsville farm 296 spring pigs were treated with the same dosage of the same lot of virus and serum, which resulted, however, in a hog-cholera break complicated with lung lesions which were characteristic of "flu" infection. This condition is being investigated in the Biochemic Division.

#### VITAMIN STUDIES

The studies of the immediate and ultimate effects of rations deficient in vitamins on the growth, development, and reproduction of hogs, and on the meat from hogs, are being continued in cooperation with the Biochemic Division.

#### SHEEP AND GOAT INVESTIGATIONS

##### FARM-SHEEP INVESTIGATIONS

Studies of farm-sheep problems were conducted at Beltsville, Md., Middlebury, Vt., La Fayette, Ind., Newell, S. Dak., and McNeill, Miss.

At Beltsville the experiments consist of (1) the development of a practical system of forage-crop pastures for sheep, (2) effects of flushing (extra feed at breeding time) on lamb yields, (3) growth in lambs and wool, and (4) type fixing of purebred sheep.

The forage-crop investigations have shown that sheep can be raised successfully by using forage crops to provide the entire summer pasturage. The flushing experiment was conducted in a manner similar to that used in the previous nine years' work. The results were in general similar to those previously obtained. An exception occurred, however, with Hampshire ewes, in whose case flushing was a disadvantage. This exception shows that there may be certain requirements still unknown in the manner of feeding and types of feed best suited to various breeds of sheep. The variation in this one test is so slight that it reduces the average for the 10 years' work only 1.3 lambs per 100 ewes, leaving an advantage in favor of flushing amounting to 16.4 lambs per 100 ewes for the 10-year period. Growth studies were continued by means of weekly weighings of all and biweekly measurements of representative lambs of the Southdown, Shropshire, and Hampshire breeds. Type fixing of Southdown, Shropshire, Hampshire, and Corriedale sheep was continued by selective breeding, based on the bureau's detailed scoring system. The Beltsville flock on June 30 consisted of 358 sheep and lambs of the four breeds.

At Middlebury experiments consisted of (1) the effect of flushing on lamb yields, (2) growth studies, (3) grading up farm sheep, and (4) relative profits obtained in the production of castrated and uncastrated lambs. The flushing test showed an advantage of 18.8 lambs per 100 ewes as a result of extra feed at breeding time. Growth studies were conducted by means of weekly weighings of all lambs and biweekly weighings of mature stock. Grading up was continued by the mating of the first, second, and third cross Shropshire and Southdown ewes to rams of their respective breeds. The first year's work on production of castrated and uncastrated lambs showed the ram lambs to be somewhat larger but not of so good finish as the wethers; neither did they dress out so well as did the wether lambs. The flock at Middlebury consists of 252 sheep and lambs.

The sheep experiments at La Fayette, begun in cooperation with Purdue University Agricultural Experiment Station, include (1) fattening of western range lambs and (2) production of market lambs under Corn Belt conditions. All these lambs are to be used in the study of factors



which influence the quality and palatability of meat. Between October and January 200 lambs that were produced at the United States Sheep Experiment Station, Dubois, Idaho, were used in the feeding experiments at La Fayette, and during January they were slaughtered at the bureau's experimental abattoir, Beltsville, where extensive records were obtained on each lamb. The quality and palatability of the meat from these lambs were studied in cooperation with the Bureaus of Agricultural Economics, Home Economics, and Chemistry. Results indicate that breed and feed were of importance as factors which influence the quality and palatability of lamb meat. In this particular trial breed was most important.

The Purdue station has furnished a flock of 125 choice, high-grade, western Rambouillet yearling ewes and four yearling Shropshire rams for use in the study of lamb production under Corn Belt conditions. This work will be conducted to study four types of management that are practiced in the Corn Belt on which there is need of definite information.

The sheep experiments in progress at Newell, S. Dak., apply to the conditions of irrigation agriculture of the northern Great Plains. They consist of studies in (1) pasture utilization with sheep, (2) sheep feeding, (3) lamb production, and (4) wool production. Hampshire sheep are proving to be especially well adapted to the conditions of irrigation agriculture at Newell, where good sheep feed such as alfalfa grows in abundance. Farmers are watching this work with interest and the results of these studies should be useful to sheep raisers on the irrigation projects of the North. The Newell flock numbers 167 sheep and lambs.

The limiting factor in sheep production at McNeill, Miss., continues to be largely the problem of internal parasites. By providing as much as 10 acres or more per sheep, frequent changes of pasture, and a monthly medicinal treatment with a solution of 1 per cent copper sulphate and 1 per cent nicotine sulphate, in water, the bureau has been able to raise lambs to breeding age. But in order to raise sheep economically a greater degree of success in controlling internal parasites seems necessary. Plans for solving this fundamental problem are discussed under the work of the Zoological Division. A flock of about 185 experimental ewes and lambs is now on hand at the McNeill station.

#### RANGE-SHEEP INVESTIGATIONS

Problems of the range-sheep industry are under investigation at Dubois, Idaho, and Miles City, Mont. The studies in Idaho apply particularly to the intermountain region and the experiments in Montana should be especially serviceable to the northern Great Plains.

At Dubois the experiments are organized into the following projects: (1) Range utilization, (2) wool production, (3) lamb production, and (4) sheep breeding. The studies of range use are conducted cooperatively with the Forest Service. Sufficient data are now available on the wool-production experiments to justify some important conclusions and they are being used in the preparation of a bulletin on factors which influence wool production of range Rambouillet sheep.

Experiments in lamb production under range conditions of the intermountain region have now been in progress two full years. This is being conducted with a band of 1,200 ewes, half Rambouillets and half Corriedales. Half of the Rambouillet ewes are bred to Rambouillet rams and the other half to Hampshires; half of the Corriedale ewes are bred to Corriedale rams and the other half to Hampshires. Corriedale ewes have yielded considerably larger lambing percentages than Rambouillet ewes, and lambs sired by Hampshire rams average heavier than the Rambouillet or Corriedale lambs when they are finished for market under conditions of good summer range.

The study of range sheep breeding continues with Rambouillets, Corriedales, Columbias, and the Corriedale and Columbia cross. Progress in the improvement of Rambouillet, Corriedale, and Columbia sheep is encouraging and shows the practicability of the bureau's system of selective mating by the use of the score records of individual sheep. Approximately 4,800 sheep and lambs are on hand at the Dubois station.

Range-sheep investigations at Miles City cover (1) range utilization, (2) feeding, (3) studies in wool, and (4) lamb production. Definite experiments in range utilization await special fencing and equipment, and the cooperation of the Forest Service for specific vegetation studies. Experiments in feeding have been conducted with both breeding ewes and feeder lambs. Lambs from ewes receiving grain during the winter averaged slightly heavier at birth than the lambs from ewes that had no



grain during the winter. This work is being continued. Lamb fattening during the fall and early winter was carried on with about 400 lambs. Rations of screenings and alfalfa hay versus screenings, alfalfa hay, and corn silage were compared and for the second successive season. The one containing silage showed a slight advantage.

Wool studies were continued by scoring for fineness and character, measuring the length of staple and recording the weight of the fleece of each sheep. Some of the fleeces were also tested for shrinkage. These data are to be used in a comprehensive study of the factors which influence the quantity and quality of wool produced.

Lamb production is being studied to determine the influence of such factors as type, conformation and age of breeding ewes and rams, and methods of feeding, grazing, and management. A mass of data is being collected on this project which will be analyzed by the use of statistical machinery. About 1,800 sheep and lambs are on hand at the Miles City station.

#### STUDIES IN WOOL AND OTHER ANIMAL FIBERS

Research was conducted with wool and other animal fibers in respect to (1) the yield of clean wool and the content of grease and dirt of fleeces from about 1,500 sheep that were specially bred or specially fed; (2) methods of mixing wool to obtain uniform samples; (3) studies in moisture content of wool; (4) studies of wool-scouring processes and methods of determining the shrinkage of wool; (5) measuring the diameters of fibers of spinning-count samples of wool and establishing technical scoring standards for the use of bureau investigators in judging the fineness of wool; (6) studies in the growth of wool and hair; (7) investigations of the structure of wool and mohair fibers; and (8) committee work on Government purchase specifications for curled hair to be used in mattresses, pillows, and upholstery.

Field work on wool was conducted with sheep at bureau stations at Dubois, Idaho; Miles City, Mont.; Beltsville, Md.; Middlebury, Vt.; and on farms of the State agricultural experiment stations of Minnesota, Indiana, Wyoming, Idaho, and Washington. At the State stations the work consisted largely of studies in the

growth of wool and was handled through active cooperation.

#### GOAT INVESTIGATIONS

Toggenburg and Saanen goats were used at Beltsville, Md., in the study of problems of breeding, feeding, and milk production. The results furnish valuable data and the breeding stock has been considerably improved. The herd at Beltsville numbers 64 goats, including kids.

At the Iberia Livestock Experiment Farm, Jeanerette, La., experiments are under way with common does and a Saanen buck in which studies are being made of the problems of breeding, feeding, and milk production under conditions of the Coastal Plains. Forty-one goats and kids were at the Jeanerette station in June.

A purebred Angora buck has been placed at the Coastal Plain Experiment Station, McNeill, Miss., for use on native does of that region in a study of factors which influence the growth and quality of mohair.

#### HORSE AND MULE INVESTIGATIONS

Horse investigations were conducted during the fiscal year at the United States Morgan Horse Farm, Middlebury, Vt.; at the United States Wyoming Horse Breeding Station, Laramie, Wyo.; and at the United States Range Livestock Experiment Station, Miles City, Mont.

#### BREEDING MORGAN HORSES

The animals in the stud at the Morgan Horse Farm are being used for obtaining data relating to the production and use of light horses under New England conditions.

A study of the problem of wintering idle brood mares was begun in 1909. Results to date indicate that the best type of shed is one that opens to the south, with hay rack along the inclosed side, with storage space above, and so arranged that one man can feed twice daily and otherwise care for 12 or 15 horses in not over one hour daily on the average. This reduces the labor charge, as compared with the box-stall method of housing, and the mares are generally kept in better health.

The feeding of silage to mares in foal has also been studied for several years along with the method described of housing horses in open sheds. Results obtained in these experiments indicate that silage is a safe feed for horses when fed not in excess of 10 pounds a day, and provided frozen

or moldy silage is not used. Eighteen pounds of good-quality mixed hay, 10 pounds of corn silage, and 10 pounds of whole oats is a safe, practical, and economical daily ration for brood mares in New England, where severe winters are the rule. These conclusions are arrived at after observing mares in various stages of pregnancy, and taking into consideration the health and vigor of resulting foals. The quality of animals produced in this work is improved each year.

Studies have been made to determine the endurance and stamina of purebred and grade Morgan horses by actual tests in comparison with representative horses of other breeds, and also to obtain data regarding methods of training and conditioning horses for long and severe tests. Horses produced in this project made a very creditable showing in the 1926, 300-mile endurance ride, held under the sponsorship of various horse associations. The most notable of these was the performance of the purebred mare Jessie which completed the ride in the minimum time allowance of 45 hours, and of the purebred mare Eudora which completed the test in a few minutes over the minimum time allowance. Eudora produced a splendid foal this spring, which further emphasizes her remarkable performance, as she is the first mare to complete a test of this kind while carrying a foal.

In a correlation of the period of pregnancy of mares with season of foaling, results indicate that mares foaling during the cooler months carry their foals over the average gestation period, and that mares foaling during the warmer months deliver their foals a few days ahead of the average gestation period.

Stallions from this farm stand for public service throughout New England, and breeding stock has been sent to many parts of the United States and to Porto Rico, Guam, Japan, and Central America. The demand for breeding animals far exceeds the supply or the capacity of the farm with the present stud of brood mares to produce them. The stud consists of 55 animals of all ages.

#### BREEDING AMERICAN UTILITY HORSES

The breeding of American utility horses was continued during the past year in cooperation with the University of Wyoming, Laramie, Wyo., and the stud has consisted of 40 animals of all ages. The horses in this proj-

ect are being used for studies relating to the production of light horses under range and western farm conditions, to test the virility of breeding sires, and to obtain data on the salt requirements for horses on range pastures. The average mature horse at this station consumes 0.6 ounce of salt per day, which is somewhat under the presumed normal requirement. This has been explained because under western conditions the native hay contains a larger amount of salt, particularly where it has been produced under irrigation. It is proposed to terminate the work at this station about September 15, 1926, and transfer all the horses to the United States Range Livestock Experiment Station, Miles City, Mont.

#### BREEDING INVESTIGATIONS UNDER RANGE CONDITIONS

During the last fiscal year 31 purebred Morgan horses were obtained for establishing a foundation stud at the Miles City station, and for conducting investigations in the production of purebred saddle horses under range conditions. These consisted of 1 stallion, 7 mature brood mares, and 23 other animals of various ages. A Thoroughbred stallion, loaned by the Remount Service of the War Department, is being used for grading up range mares in the production of saddle horses.

A further addition to the horse equipment at this station was the purchase of a purebred Belgian stallion named Rowdy and two purebred Belgian mares, together with several grade mares, for investigations in producing draft horses under range conditions.

#### CERTIFICATION OF ANIMALS IMPORTED FOR BREEDING PURPOSES

Under the provisions of paragraph 1506 of the tariff act of 1922, the bureau issued certificates of pure breeding during the fiscal year for 1,434 cattle, 1,477 sheep, 371 horses, 24 swine, 1,913 dogs, and 9 cats, a total of 5,228 animals.

#### POULTRY INVESTIGATIONS

During the year considerable time was devoted to the formulation of a uniform plan of accreditation and certification of hatcheries and breeding flocks. Cooperation was instituted with the management of official egg-laying contests in respect to the adoption of uniform rules and regulations



for the numerous contests. Plans were also made for the participation of the United States in the World's Poultry Congress to be held at Ottawa, Canada, July 27 to August 4, 1927.

The investigational work under way at the United States Experiment Farm, Beltsville, Md., was continued and plans made for new projects.

#### POULTRY BREEDING

The regular breeding work for increased egg production with Rhode Island Reds and Single-Comb White Leghorns was continued, and during the year in both breeds there was a higher proportion of 200-egg records than during any previous year. The results in respect to fertility and hatchability of the eggs and to chick mortality up to 4 weeks of age for the years 1925 and 1926 were briefly as follows:

Fertility of eggs for the Leghorns increased from 90.56 per cent in 1925 to 93.12 per cent in 1926. Fertility for Rhode Island Reds was higher in both years, viz, 93.64 per cent in 1925, and 94.20 per cent in 1926.

Hatchability of fertile eggs was practically identical for both breeds in 1926—68.15 per cent for Leghorns and 68.20 per cent for Rhode Island Reds. In 1925, however, the Leghorns averaged 70.83 per cent as against 67.87 per cent for Rhode Island Reds.

In chick mortality the Leghorns showed a still greater variation, averaging 5.15 per cent in 1926 and 15.22 per cent in 1925. The corresponding averages for Rhode Island Reds were 10.01 and 12.96, respectively.

The biological study of hen feathering in crossbred Golden-Spangled Hamburg and Brown Leghorn stock was continued in two matings.

Other matings were made in a general study of color and structure inheritance, this work serving as a groundwork for the study of the inheritance of more fundamental characters.

#### POULTRY FEEDING

The experiments begun last year in studying the relative value of various quantities of protein in meat scrap and in dried skim milk have been continued, the test including 16 pens of from 20 to 25 hens each.

The lowest protein ration, containing 7.7 per cent with both the meat and milk rations, produced only 15 eggs per hen, which were laid in the spring months. Both the size and shape of these eggs were affected by the rations,

being slightly under normal size with a tendency toward a long, narrow shape. Egg production showed a regular, rapid increase in these tests with increasing percentages of protein up to about 16 per cent. The meat protein continued to give a steady increase in production in the pens receiving from 16 to 20 per cent protein, but the rate of increase was much lower than that obtained below 16 per cent protein. The highest meat protein used, 25.5 per cent, gave a moderately increased egg production in the pullet year, but is not giving so high production as the 20 per cent protein in the second or yearling year. The other protein rations are giving practically the same relative productions in the yearling as they gave in the pullet year.

The pens on dried skimmed milk have given relatively better egg production than the meat-protein pens between the 7.7 and 14 per cent protein levels. Egg production in the milk-fed pens increased slightly, but at a much lower rate, from 14 to 18 per cent protein, while 20 per cent, the highest milk protein used, gave no greater egg production than 18 per cent.

The three months' preliminary tests in feeding varying quantities of limestone to pullets, started late in the laying year, gave no marked differences either in the egg production or in the shell texture. This experiment was repeated on a much larger scale, using 11 pens of 13 pullets each. The limestone added to the rations varied from 0 to 12 per cent. Omitting limestone from the ration reduced egg production 50 per cent, and the hens produced wet droppings throughout the test. The same results were obtained when gypsum grit was used. Limestone grit gave fair production equal to that received from 2 per cent limestone. Egg production was practically the same in the pens, receiving from 4 to 8 per cent limestone, while production decreased considerably in the 12 per cent limestone pens. The percentage of limestone has affected egg production much more than it has affected the shell texture. The hens receiving no additional lime for eight months are still laying eggs with fairly good shells, but which show a tendency toward becoming somewhat weaker.

Three experiments have been conducted to show the effect of varying quantities of protein in the rations for growing chicks, somewhat similar to the tests with hens. The chicks are



confined to a brooder house which has small, concrete, outside yards where the chicks are kept from 12 to 18 weeks. The lowest protein used, 10.5 per cent, has given very poor growth in every instance. Increasing the protein has given uniformly increased growth up to 17.5 per cent. The next higher protein used, 21.5 per cent, gave poorer growth in the first tests but better growth in the last test, in which yeast as a source of vitamin B was used. The yeast showed only a slight improvement at the other protein levels. Cod-liver oil was used in most of the tests and omitting this oil from the rations resulted in greatly increased mortality and much poorer growth. None of the experimental rations made of corn meal and dextrine gave as good results as the normal chick ration. Considerable leg weakness developed with these experimental rations even with the cod-liver oil added and the use of a small, outside yard. Increasing the mineral content of the rations caused no improvement.

#### GLENDALE SUBSTATION

Work with chickens and turkeys is in progress at the poultry-experiment substation at Glendale, Ariz. The work with chickens was confined primarily to a study of the inheritance of egg production. The turkey project has to do primarily with a study in costs of raising turkeys.

#### MEAT INSPECTION DIVISION

The work of the Federal meat-inspection service, conducted under R. P. Steddom, chief, shows an increase in the slaughter of all classes of animals except swine as compared with the preceding year.

#### GENERAL MEAT INSPECTION

Inspection was conducted at 913 establishments in 259 cities and towns, as compared with 910 establishments in 257 cities and towns during the fiscal year 1925. Inspection was inaugurated at 47 establishments and withdrawn from 78, as compared with 42 and 44, respectively, during the preceding year. Inspection was withdrawn from 63 of these establishments on account of the discontinuance of slaughtering, interstate or regular business; from 10 on account of transfer to market inspection; from 3 on account of insanitary conditions, and from 2 on account of violation of the regulations.

#### ANTE-MORTEM AND POST-MORTEM INSPECTIONS

The ante-mortem and post-mortem inspections are given in the following tables:

TABLE 1.—*Ante-mortem inspection of animals*

Class of animals	Passed	Suspected <sup>1</sup>	Condemned <sup>2</sup>	Total animals
Cattle.....	9,754,631	340,578	18	10,095,227
Calves.....	5,294,183	7,470	31	5,301,684
Sheep.....	12,317,414	3,054	4	12,320,471
Goats.....	42,745	31	-----	42,776
Swine.....	40,365,244	79,037	1,348	40,445,630
Horses.....	39,662	6	2	39,670
Total.....	67,813,879	430,176	1,403	68,245,458

<sup>1</sup> This term is used to designate animals suspected of being affected with any disease or condition that may cause condemnation in whole or in part on special post-mortem inspection.

<sup>2</sup> For additional condemnations see succeeding tables.

TABLE 2.—*Post-mortem inspection of animals*

Class of animals	Passed	Condemned	Total carcasses
Cattle.....	9,994,485	103,636	10,098,121
Calves.....	5,299,841	11,933	5,311,774
Sheep.....	12,339,763	14,462	12,354,225
Goats.....	42,689	85	42,774
Swine.....	40,299,704	143,026	40,442,730
Horses.....	39,603	65	39,668
Total.....	68,016,085	273,207	68,289,292

Tables 3 and 4 show the diseases and conditions for which condemnations were made.

TABLE 3.—*Diseases and conditions for which condemnations were made on ante-mortem inspection*

Cause of condemnation	Cattle	Calves	Sheep	Swine
Abscess.....	-----	-----	-----	51
Arthritis.....	1	-----	-----	4
Emaciation.....	-----	-----	-----	12
Hog cholera.....	-----	-----	-----	503
Immaturity.....	1	28	-----	-----
Injuries.....	-----	1	2	-----
Melanosis.....	-----	-----	-----	1
Moribund.....	-----	-----	-----	32
Parturition.....	1	-----	-----	-----
Pneumonia.....	6	-----	-----	17
Pyemia.....	-----	-----	-----	8
Pyrexia <sup>1</sup> .....	9	2	1	720
Tetanus.....	-----	-----	1	-----
Total.....	18	31	4	1,348

<sup>1</sup> Two horses condemned in addition to the other animals.

TABLE 4.—*Diseases and conditions for which condemnations were made on post-mortem inspection*

Cause of condemnation	Cattle		Calves		Sheep	
	Car-casses	Parts	Car-casses	Parts	Car-casses	Parts
Actinomycosis	673	108,605	16	1,713	11	-----
Asphyxia	2	-----	5	-----	-----	-----
Blackleg	7	-----	7	28	-----	-----
Bone diseases	155	23	118	-----	331	121
Caseous lymphadenitis	-----	-----	-----	-----	1,437	-----
Cellulitis	-----	1	-----	-----	-----	-----
Congestion	10	19	2	1	4	-----
Contamination	9	149	5	19	1	9
Cysticercus	129	1,904	26	9	211	-----
Dropsical diseases	19	-----	-----	-----	15	-----
Emaciation	7,863	-----	1,819	-----	3,352	-----
Gangrene	93	-----	35	-----	2	-----
Hydronephrosis	1	-----	-----	-----	-----	-----
Icterus	71	-----	154	-----	1,408	-----
Immaturity	-----	-----	4,450	-----	-----	-----
Injuries, bruises, etc.	5,677	583	907	115	666	256
Leukemia	686	-----	25	1	7	-----
Melanosis	26	16	51	4	11	-----
Moribund	17	-----	1	-----	14	-----
Necrobacillosis	8	-----	1	-----	-----	-----
Necrosis	3	1,145	-----	-----	3	-----
Parasitic diseases	22	36	2	1	11	-----
Phlebitis	-----	-----	89	-----	-----	-----
Pneumonia, peritonitis, enteritis, metritis, pleurisy, etc.	10,567	-----	2,270	-----	5,533	-----
Pregnancy and recent parturition	70	-----	-----	-----	9	-----
Rabies	1	-----	-----	-----	-----	-----
Septicemia, pyemia, uremia, etc.	5,074	-----	1,077	-----	1,265	-----
Sexual odor	2	-----	-----	-----	1	-----
Skin diseases	-----	-----	-----	-----	2	-----
Texas fever	90	-----	134	-----	-----	-----
Tuberculosis	70,604	101,757	687	772	-----	-----
Tumors and abscesses	1,757	3,940	52	431	168	35
Total	103,636	218,178	11,933	3,094	14,462	421

Causes of condemnation	Goats		Swine		Horses	
	Car-casses	Parts	Car-casses	Parts	Car-casses	Parts
Actinomycosis	-----	-----	1	63	-----	-----
Anthrax	-----	-----	3	-----	-----	-----
Asphyxia	-----	-----	1,007	-----	-----	-----
Bone diseases	2	-----	6,896	171	-----	-----
Caseous lymphadenitis	5	-----	-----	-----	-----	-----
Cellulitis	-----	-----	24	517	-----	-----
Congestion	-----	-----	7	2	-----	-----
Contamination	-----	-----	661	3,198	-----	-----
Cysticercus	-----	-----	76	9	-----	-----
Dropsical diseases	-----	-----	48	-----	1	-----
Emaciation	50	-----	953	-----	7	-----
Gangrene	-----	-----	17	-----	-----	-----
Hog cholera	-----	-----	17,091	-----	-----	-----
Hydronephrosis	-----	-----	44	-----	-----	-----
Icterus	2	-----	3,965	-----	-----	-----
Injuries, bruises, etc.	7	1	1,465	7,817	2	1
Leukemia	-----	-----	219	-----	-----	-----
Melanosis	-----	-----	94	-----	3	-----
Moribund	1	-----	139	-----	-----	-----
Necrobacillosis	-----	-----	1	-----	-----	-----
Necrosis	-----	-----	5	1	-----	-----
Parasitic diseases	-----	-----	67	-----	-----	-----
Pneumonia, peritonitis, enteritis, metritis, pleurisy, etc.	10	-----	22,408	-----	24	-----
Pregnancy and recent parturition	-----	-----	53	-----	3	-----
Septicemia, pyemia, uremia, etc.	7	-----	19,265	-----	15	-----
Sexual odor	1	-----	2,265	-----	-----	-----
Skin diseases	-----	-----	66	-----	-----	-----
Tuberculosis	-----	-----	63,748	636,707	-----	-----
Tumors and abscesses	1	1	2,438	238,788	10	-----
Total	85	2	143,026	887,273	65	1

Table 5 shows the total condemnations on ante-mortem and post-mortem inspections combined.

TABLE 5.—*Summary of condemnations*

Class of animals	Animals or carcasses	Parts
Cattle.....	103,654	218, 178
Calves.....	19,964	3,094
Sheep.....	14,466	421
Goats.....	85	2
Swine.....	144,374	887,273
Horses.....	67	1
Total.....	282,610	1,108,969

In addition the carcasses of 56,361 animals found dead or in a dying condition were tanked as follows: Cattle, 4,917; calves, 5,450; sheep, 8,693; goats, 70; swine, 37,103; horses, 128.

## INSPECTION OF MEAT AND PRODUCTS

The inspection and supervision of meats and products prepared and processed are shown in Table 6, which is a record only of inspection performed and not a statement of the actual quantity prepared. The record of inspection is sometimes duplicated when the product is reinspected during the different stages of preparation.

TABLE 6.—*Meat and meat food products prepared and processed under supervision*

Kind of product	Inspection (pounds)
Placed in cure:	
Beef.....	168,107,465
Pork.....	2,850,675,434
All other.....	15,161,571
Sausage chopped.....	771,741,210
Canned product:	
Beef.....	182,796,663
Pork.....	24,955,509
All other.....	6,414,279
Sterilized product:	
Beef.....	5,254,791
Pork.....	8,852,218
All other.....	3,600
Pork to be eaten uncooked.....	47,790,190
Meat extract.....	572,636
Lard.....	1,598,753,775
Lard oil.....	1,410,924
Lard stearin.....	1,122,522
Compound and other substitutes for lard.....	543,913,073
Oleo stock and edible tallow.....	64,563,172
Oleo oil.....	143,618,876
Oleostearin.....	67,453,692
Oleomargarin.....	148,331,128
Miscellaneous.....	1,751,895,095

TABLE 6.—*Meat and meat food products prepared and processed under supervision—Continued*

Kind of product	Inspection (pounds)
Horse meat:	
Cured.....	7,223,890
Canned.....	457,858
Total.....	8,411,069,571

The following quantities of meat and meat food products were condemned on reinspection and destroyed for food purposes on account of having become sour, tainted, unclean, rancid, or otherwise unwholesome: Beef, 3,098,346 pounds; pork, 5,674,386 pounds; mutton, 41,972 pounds; veal, 49,519 pounds; goat meat, 176 pounds; horse meat, 12,210 pounds; total, 8,870,609 pounds.

## MARKET INSPECTION

Market inspection, to facilitate interstate deliveries of meats and products, was conducted in 25 cities.

## MEATS AND PRODUCTS CERTIFIED FOR EXPORT

During the fiscal year a total of 105,512 official meat-inspection certificates were issued to cover the exportation of the following products: Beef and beef products, 168,724,833 pounds; mutton and mutton products, 3,009,641 pounds; pork and pork products, 1,156,844,634 pounds; horse-meat products, 5,402,652 pounds; total, 1,333,981,760 pounds. There were also issued 4,677 certificates covering the exportation of 71,451,763 pounds of inedible animal products.

## EXEMPTION FROM INSPECTION

The provisions of the meat-inspection law requiring inspection usually do not apply to animals slaughtered by a farmer on the farm or to retail butchers and dealers supplying their customers. The retail butchers and dealers, however, in order to ship meat and meat food products in interstate or foreign commerce, are required to obtain certificates of exemption. The number of such certificates outstanding at the close of the fiscal year was 1,736. During the year 68 certificates were canceled, 54 on account of dealers' retiring from business or ceasing to make interstate shipments, 10 on account of change in address, 2 for insanitary conditions, 1 for violations of the meat-inspection regulations, and 1 on account of handling inspected meats only.

During the year 34,903 shipments were made by retail butchers and



dealers holding certificates of exemption, as compared with 31,442 shipments during the fiscal year 1925. The shipments of the year covered products as shown in Table 7.

TABLE 7.—*Shipments by retail butchers and dealers under certificates of exemption*

Product	Carcasses	Pounds
Beef, carcasses (169 quarters).....	42	19, 012
Veal, carcasses.....	18, 654	2, 455, 468
Sheep, carcasses.....	957	39, 502
Swine, carcasses.....	145	15, 858
Beef, fresh.....		778, 689
Veal, fresh.....		249, 077
Mutton, fresh.....		139, 350
Pork, fresh.....		72, 203
Cured meats.....		380, 910
Lard.....		12, 796
Sausage.....		96, 369
Miscellaneous (scrapple, lard substitutes, suet, head cheese, etc.).....		21, 026
Total.....	19, 828	4, 280, 260

During the year 61,074 interstate shipments were made of meat and meat food products from animals slaughtered by farmers on the farm, as compared with 64,093 shipments made in the fiscal year 1925. The products composing these shipments are shown in Table 8:

TABLE 8.—*Shipments of farm-slaughtered products under exemption from inspection*

Product	Carcasses	Pounds
Beef, carcasses (635 quarters).....	159	67, 812
Veal, carcasses.....	83, 488	7, 053, 629
Sheep, carcasses.....	5, 110	183, 683
Swine, carcasses.....	3, 205	344, 638
Beef, fresh.....		76, 099
Veal, fresh.....		35, 505
Mutton, fresh.....		2, 027
Pork, fresh.....		104, 873
Cured meats.....		386, 641
Lard.....		32, 393
Sausage.....		74, 820
Miscellaneous (scrapple, livers, mincemeat, head cheese, etc.).....		8, 606
Total.....	91, 962	8, 370, 726

#### INSPECTION OF IMPORTED MEATS

Table 9 shows the inspection of imported meat and meat food products for the fiscal year.

TABLE 9.—*Imported meat and meat food products inspected and passed*

Country of origin	Fresh and refrigerated meats	
	Beef	Other classes
	<i>Pounds</i>	<i>Pounds</i>
Argentina.....	655, 534	812, 311
Australia.....	104	945
Brazil.....	72	
Canada.....	9, 156, 272	11, 584, 782
Uruguay.....	163, 377	655
Other countries.....		3, 537
Total.....	9, 975, 359	12, 402, 230

Country of origin	Cured and canned meats	Other products	Total weight
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Argentina.....	8, 724, 646	912, 197	11, 104, 638
Australia.....	87, 432	434, 600	523, 081
Brazil.....	472, 812		472, 884
Canada.....	1, 582, 425	1, 063, 681	23, 387, 160
Uruguay.....	7, 720, 088	162, 473	8, 046, 593
Other countries.....	670, 998	572, 017	1, 246, 552
Total.....	19, 258, 401	3, 144, 968	44, 780, 958

Table 10 shows the quantities of foreign meat and products excluded from the country because of unsoundness, presence of prohibited preservative, or other failure to comply with the regulations.

TABLE 10.—*Imported meat and meat food products condemned and refused entry*

Product	Condemned	Refused entry
	<i>Pounds</i>	<i>Pounds</i>
Beef.....	13, 117	2, 466
Veal.....		280
Mutton.....	53	42
Pork.....	14, 900	17, 651
Total.....	28, 070	20, 439

#### INSPECTIONS FOR OTHER BRANCHES OF THE GOVERNMENT

By request of other branches of the Government, reinspections of meat and meat food products to determine whether they remained wholesome and conformed to certain specifications were made during the year as shown in Table 11.

TABLE 11.—*Inspections for other branches of the Government*

Branch of Government	Passed	Rejected
	<i>Pounds</i>	<i>Pounds</i>
Navy Department.....	43,959,843	1,364,705
Marine Corps.....	3,502,669	111,727
War Department.....	576,932	5,554
Interior Department (Indian Affairs).....	533,899	695
U. S. Shipping Board.....	1,510,009	41,682
Public Health Service.....	207,807	2,559
U. S. Veterans' Bureau.....	373,500	-----
Panama Railroad.....	7,944	300
Coast Guard.....	10,451	-----
Total.....	50,683,054	1,527,222

**MEAT-INSPECTION LABORATORIES**

Analyses and examinations of meat and products were conducted in the meat-inspection laboratories situated in the several districts throughout the country.

The total number of samples analyzed was 45,752, of which 674 represented meat and meat food products offered for importation. Samples of 2,259 domestic and 98 foreign products were found not to be in accordance with the regulations.

Samples of water supplies of official establishments, curing materials, spices, condiments, cereals, coloring materials, denaturing oils, etc., were examined. Of 1,743 water samples, 226 showed evidence of pollution.

Experiments with the use of sodium nitrite were completed and its use as a curing agent is now permitted. This substance is now employed with satisfactory results.

The study of the dry-rendering process was continued and results indicate that the process is a safe method for the disposal of condemned product.

Other special studies have dealt with the use of cereal in sausage, with the composition and food value of Frankfurter-style sausage, with the correct proportions of nitrate for curing, and the use of hypochlorite for disinfection.

**LABELING MEAT AND PRODUCTS**

The official approvals of meat labels for the year were 12,729, an increase of 2,555 over those of the preceding year. This increase was due primarily to stimulated activities in the meat-canning industry. The approval of 18,417 labels was rescinded as the result of continued activity in the elimination from the files of labels which had become obsolete and those

which were covered by blanket approval. Approval was denied 881 labels and other markings which did not conform to the regulations.

A large volume of correspondence was conducted and many conferences were held in the administration of the labeling regulations, with particular reference to those involving marking of sausage, sausage substitutes, barbecued meats, and baby beef. A number of definitions and standards for meat and products were considered in cooperation with the joint committee on definitions and standards, and the Bureau of Agricultural Economics.

Consideration was given requests by the meat-packing industry that terms of geographical origin which have long been established and associated with specific kinds of products, be adopted as purely generic. Final decision on these requests must be held in abeyance pending the adoption of standards whereby the types of products may be definitely recognized.

**FIELD INSPECTION DIVISION**

The Field Inspection Division, under A. W. Miller, chief, continued its regular activities for the control and eradication of certain diseases of livestock, the enforcement of livestock quarantine and transportation laws, and the administration of regulations governing the importation and exportation of livestock and those providing for the sanitary handling of hides, skins, wool, other animal by-products, hay, straw, forage, fertilizers, etc., offered for importation into the United States. In addition the division conducted the work of eradicating foot-and-mouth disease and European fowl pest.

**ERADICATION OF FOOT-AND-MOUTH DISEASE****CALIFORNIA FREE FROM DISEASE**

There was no recurrence of foot-and-mouth disease in California during the year. The campaign against possible infection among deer was continued until April 30, 1926, but as none of the animals taken since the beginning of the fiscal year had exhibited any symptoms of the disease, hunting operations were discontinued.

Early in September, 1925, about 1,000 head of test cattle were placed on the ranges in the Stanislaus National Forest on which infected deer had been found. These cattle were distributed over those ranges in lots of such size that they could be easily handled. Each lot was under the

personal supervision of a veterinary inspector experienced in foot-and-mouth-disease eradication work. These animals were kept in the forest until the advent of cold weather and heavy snows. None of them developed any symptoms of the disease. This forest was opened to grazing on May 1, 1926. The cattle and sheep entering the forest were accompanied by inspectors who will keep them under close observation throughout the grazing season. All quarantine restrictions were removed from the State on June 10, 1926.

#### RECURRENCE OF FOOT-AND-MOUTH DISEASE IN TEXAS

An outbreak of foot-and-mouth disease in Texas was officially confirmed on July 30, 1925. The source of the infection has not been definitely determined, but it is believed that the outbreak was a recurrence and not a reintroduction of the disease. The first infection was found in a herd of cattle in the same pasture in which the disease made its initial appearance in the outbreak in 1924. A force of experienced bureau employees, some of whom were on the ground before the disease was positively diagnosed, was assembled at Houston. This force at its peak consisted of 86 men. On September 23, 1925, at the request of Gov. Miriam A. Ferguson, the department took full charge of the work of eradicating the disease. The combined State and Federal forces were placed under the direction of Marion Imes, of the bureau.

On July 31, 1925, the department issued an order quarantining a portion of Harris County and on the same day the first diseased herd was slaughtered and incinerated. Following the discovery of infection on the open range, the quarantine was extended on August 8 to cover the remainder of Harris County and portions of Galveston and Brazoria Counties. On the appearance of the disease in range cattle in Galveston County, additional territory in that county and also in Brazoria County was quarantined on September 5.

The infection in cattle on the open range made it necessary to gather and destroy several thousand cattle in order to break contact between diseased herds and those that had not been exposed. The opposition of a few owners who went into Texas district courts and obtained temporary injunctions restraining the slaughter of their herds was another obstacle which made eradication work very difficult, but in spite of these adverse

conditions outbreaks of the disease occurred only in Harris and Galveston Counties. The last known diseased herd was found on October 14, 1925, and destroyed the following day.

On November 28 restrictions were removed from a considerable part of the quarantined area and on the same day the testing of infected premises was commenced. The testing and restocking of such premises were completed the latter part of March, 1926, all the animals used for these purposes remaining free from the disease. On April 1, 1926, all quarantine restrictions were removed, but several veterinary inspectors were retained at Houston to perform scout duty until all danger of a recurrence of the disease had passed.

#### STATISTICS OF ERADICATION

The number of animals slaughtered, together with the appraised value of the livestock and property destroyed, is shown in Table 12.

TABLE 12.—*Livestock slaughtered in Texas because of foot-and-mouth disease, with appraised values, during the fiscal year 1926*

County	Herds		Cattle	Swine
	In-fected	Ex-posed		
Harris.....	96	629	12,314	630
Galveston.....	57	201	8,369	99
Brazoria.....	0	18	167	23
Total live-stock.....	153	848	20,850	752

County	Sheep	Goats	Total animals	Ap-praised value
Harris.....	811	342	14,097	\$360,499.32
Galveston.....	587	3	9,058	288,543.96
Brazoria.....	4	0	194	5,314.50
Total live-stock.....	1,402	345	23,349	654,357.78
Property ap-praisals.....	-----	-----	-----	11,056.70
Grand total.....	-----	-----	-----	665,414.48

#### ERADICATION OF EUROPEAN FOWL PEST

The outbreak of European fowl pest which occurred in the previous fiscal year, had been virtually eradicated from the United States by the beginning of the fiscal year commencing July 1, 1925. Only two outbreaks occurred during the year, one early in July in a flock of 900 chickens in New



York, the other about August 15 in a flock of 200 chickens in Delaware. The usual slaughtering and disinfection methods were employed in combating these outbreaks. Bureau employees continued to investigate suspected outbreaks of this disease but in no instance, except the two mentioned, was the diagnosis confirmed. As a precautionary measure, cars regularly used in the transportation of poultry were cleaned and disinfected under bureau supervision. The number of cars so treated was 16,274.

#### ERADICATION OF SCABIES

In the work of eradicating sheep scabies, which was continued in cooperation with State officials, inspectors in the field made 23,391,576 inspections and supervised 3,176,285 dippings of sheep. On inspection 969,925 sheep were found to be infected. This is approximately 18 per cent less than during the preceding year. Inspection reports indicated greater prevalence of the disease in Kansas, Nebraska, and Wyoming, but in a number of other States, especially Arizona, California, New Mexico, and Texas, infection was less extensive than during the preceding year. No infection was found in Idaho, Montana, or Nevada.

Bureau employees in cooperation with State officials working for the eradication of cattle scabies made 3,269,851 inspections and supervised 1,545,292 dippings. There were 308,787 cattle found on inspection to be infected. This was a slight decrease in the number of inspections but a considerable increase in the number of infected animals and dippings, as compared with the preceding year. In Washington, which has been free from the disease for several years, a small outbreak occurred, traceable to cattle introduced from another State. Increased infection was reported in Colorado, Nebraska, and New Mexico. In the other infected States conditions generally showed marked improvement.

#### ERADICATION OF DOURINE

The work of eradicating dourine in horses was continued in cooperation with the Office of Indian Affairs and State livestock sanitary officials. In Montana, where no outbreak of the disease has occurred since the fiscal year 1922, a small center of infection was discovered and 17 animals which reacted to the blood test were destroyed. In Arizona, the only other State in which the disease was found, infection was confined entirely to In-

dian reservations. The number of reactors on such reservations was considerably greater than for the preceding year, and little, if any, progress was made during the year in eradicating the disease. The unfavorable situation in that State is due largely to the fact that the Office of Indian Affairs does not have sufficient funds available to employ the help necessary to round up the horses for testing and to pay the Indians indemnity for the slaughter of their diseased animals. If adequate funds were furnished that office for the proper conduct of its share of the work, it is believed that the disease could be eradicated from the reservations in two or three years. The number of animals tested and the results of the tests are recorded by the Pathological Division.

#### LIVESTOCK SANITARY WORK IN INTER-STATE COMMERCE

In the course of supervising the interstate transportation of livestock to prevent the spread of animal diseases bureau employees at market centers inspected 21,699,926 cattle, of which 10,875 were dipped under supervision in order that they might continue in interstate commerce. Sheep to the number of 20,128,819 were also inspected for communicable diseases, and of these 821,659 were dipped under bureau supervision to comply with the regulations of the department or of the State at destination. Bureau employees also inspected 36,160,534 hogs and supervised the immunization and disinfection, against hog cholera, of 425,995 swine for feeding and breeding purposes. This was a reduction of 9,654,144 in the number of hogs inspected but an increase of 73,879 in the number immunized. The supply of swine suitable for immunization received at public stockyards was not sufficient to meet the requirements of farmers who desired to feed rather than sell their corn crop.

The bureau, in continuance of its efforts to prevent the spread of hemorrhagic septicemia and reduce losses from this disease, especially in feeder and stocker cattle, arranged with transportation and stockyards companies for the cleaning and disinfection under bureau supervision of railroad stockyards regularly used in the feeding, watering, and resting of livestock and also of sections of public stockyards in which this class of cattle is handled.

Bureau veterinarians inspected 25,959 horses and mules, of which 9,113 were tested with mallein, 2 showing reactions. This work was done on re-

quest of transportation companies and shippers or to comply with laws of States to which shipments were destined.

There were 41,537 cars received at bureau stations during the year carrying animals affected with communicable diseases. In compliance with department regulations or on request of Canadian Government officials, State officials, or transportation companies, 76,594 cars were cleaned and disinfected under bureau supervision.

All ruminants and swine received at public stockyards were carefully inspected for foot-and-mouth disease by experienced veterinary inspectors especially assigned to that work in order that prompt control and eradication measures might be initiated should an outbreak occur.

#### ENFORCEMENT OF TRANSPORTATION AND QUARANTINE LAWS

The bureau has continued to report to the solicitor of the department, for presentation to the Attorney General for prosecution, cases of apparent violations of the livestock transportation and quarantine laws. During the fiscal year there were submitted to the Department of Justice 227 cases of alleged violations of the 28-hour law, which prohibits the confinement of animals in cars longer than 28 hours without feed, water, and rest, and 78 cases of alleged violations of the quarantine laws and regulations. In many of these cases special investigation on the part of bureau employees was necessary for the completion of evidence. Four bureau employees were regularly assigned to this service. The greater part of the work of collecting evidence and preparing reports, however, was done by bureau employees at stockyards centers in connection with their other duties. The penalties imposed in cases decided in favor of the Government amounted to \$22,250 for violations of the livestock transportation law and \$6,105 for violations of the quarantine laws and regulations.

#### INSPECTION AND QUARANTINE OF IMPORTED ANIMALS

As in recent years, the number of animals entering the country remained relatively small. This was owing to the existence of serious animal plagues in most foreign countries and the established rule to issue no permits for the importation of domestic ruminants and swine from countries in which foot-and-mouth disease, rinderpest, contagious pleuropneumonia, or surra exists. Cattle enter-

ing the country were limited to those from Canada, Mexico, and the Channel Islands. Imports of various kinds of livestock are shown in Tables 13 and 14.

TABLE 13.—*Imported animals inspected but not quarantined*

Port of entry	Cattle	Swine	Sheep
Boston.....	-----	-----	-----
Galveston.....	-----	-----	-----
Houston.....	-----	-----	-----
Key West.....	-----	-----	-----
Los Angeles.....	-----	-----	-----
New Orleans.....	-----	-----	-----
New York.....	-----	-----	-----
Philadelphia.....	-----	-----	-----
Portland.....	-----	-----	-----
San Francisco.....	-----	-----	-----
San Juan, P. R.....	951	15	-----
Seattle.....	-----	-----	-----
Tampa.....	-----	-----	-----
Canadian border ports.....	175, 581	28, 737	34, 880
Mexican border ports.....	95, 754	2, 818	27, 728
Total.....	272, 286	31, 570	62, 608

Port of entry	Goats	Horses	Mules	Other animals
Boston.....	-----	48	-----	-----
Galveston.....	-----	-----	-----	5
Houston.....	-----	2	-----	11
Key West.....	-----	280	-----	-----
Los Angeles.....	-----	1	-----	19
New Orleans.....	-----	11	-----	-----
New York.....	-----	759	-----	5
Philadelphia.....	-----	49	-----	2
Portland.....	-----	-----	-----	30
San Francisco.....	-----	-----	-----	35
San Juan, P. R.....	11	13	32	1
Seattle.....	-----	126	-----	-----
Tampa.....	-----	-----	-----	-----
Canadian border ports.....	75	7, 636	86	452
Mexican border ports.....	7	1, 844	4, 840	77
Total.....	93	10, 769	4, 958	639

NOTE.—In addition to inspections reported in this table, animals from Mexico as follows were inspected at border ports in bond for further shipment back to Mexico: Cattle, 21,745; swine, 1,684; horses, 41; mules, 119.

TABLE 14.—*Imported animals inspected and quarantined*

Port of entry	Cattle	Swine	Sheep	Horses	Other animals
Baltimore.....	-----	-----	-----	-----	2
Boston.....	-----	-----	-----	-----	4
Los Angeles.....	-----	-----	-----	-----	4
New York.....	647	-----	4	8	109
Seattle.....	-----	-----	-----	-----	1
San Francisco.....	-----	38	5	-----	-----
Canadian border ports.....	998	90	5	5	-----
Mexican border ports.....	81	-----	-----	22	-----
Total.....	1, 726	90	47	40	123



Quail from Mexico to the number of 37,134, imported under regulations of the Bureau of Biological Survey, were inspected and quarantined by inspectors of this bureau.

Cattle from the Channel Islands were tested with tuberculin both prior to shipment and after arrival in the United States. The number of such animals thus tested during the year was 681, of which 202 were Guernseys and 479 Jerseys. Two of the animals tested gave a suspicious reaction to the test and were held for retest. All dairy and breeding cattle imported from Canada were tested at the border unless accompanied by test chart or other evidence showing them to have recently passed a satisfactory tuberculin test. Of those tested, 18 reacted to the test and were refused entry.

#### IMPORTATION OF ANIMAL BY-PRODUCTS, FEEDING MATERIALS, ETC.

The prevalence of foot-and-mouth disease in most countries of the Eastern Hemisphere and South America has led to continued care in the administration of regulations governing the sanitary handling and control of animal by-products, feeding materials, etc., offered for entry into the United States. Certificates accompanying these shipments from foreign countries are, as a rule, limited to those of a United States consular officer in the district of origin. Consequently, a large volume of imported hides, skins, animal fertilizers, and feeding materials has been uncertified and subject to restrictions after arrival in this country. Although this has imposed a heavy burden upon the bureau, it is gratifying to know that there is no evidence to indicate that infection of foot-and-mouth disease has been permitted to enter the United States through the medium of such imports, or that our domestic livestock has in any instance been infected with anthrax resulting from the handling of imported hides, skins, and other animal by-products during the year.

The Field Inspection Division has continued to require the disinfection or destruction of second-hand bags coming forward from foot-and-mouth disease-infected countries as containers of animal by-products, animal fertilizers, and certain other materials. As a result of these restrictions importers have actively endeavored to have their foreign agents use new bags, and to have consignments properly certified at the time of shipment. During the

latter part of the year, regulations to become effective on July 1, 1926, were drafted with a view to placing more rigid restrictions upon certain animal by-products, second-hand bags, and bagging from countries in which foot-and-mouth disease exists. Restrictions have been continued on hay and straw packing materials used for merchandise originating in countries where foot-and-mouth disease exists. As any such materials from an infected country must either be disinfected in an approved manner prior to shipment or disinfected or destroyed after arrival in the United States, importers, apparently, have increased their efforts to use only hay and straw which have been disinfected and certified by an American consular officer or have had their foreign agents use other materials, such as excelsior and paper cartons, against which there are no restrictions. Through cooperation of importers the volume of restricted hay and straw packing material was greatly reduced during the year and constituted considerably less than 10 per cent of the total used for import merchandise.

#### INSPECTIONS OF ANIMALS FOR EXPORT

In addition to enforcement of regulations to insure the humane handling and safe transport of export animals, inspections have been made, and, so far as possible, certificates have been issued, to meet the requirements of countries to which livestock have been shipped. Table 15 shows the number of animals of various kinds inspected for export.

TABLE 15.—*Inspection and testing of animals for export*

Kind of animals	To Canada	To other countries		Total
		American animals	Canadian animals <sup>1</sup>	
Cattle.....	860	3,443	3,343	7,646
Swine.....	13	260	.....	273
Sheep.....	8,202	2,993	.....	11,195
Goats.....	14	8	.....	22
Horses.....	986	769	83	1,838
Mules.....	208	4,393	.....	4,601
Other animals.....	.....	42	.....	42
Total.....	10,283	11,908	3,426	25,617

<sup>1</sup> Animals of Canadian origin exported through United States ports.

Inspections of 298 vessels carrying livestock were made before clearance.



For shipment to Canada 986 horses and 208 mules were tested with mallein, 860 cattle were tested with tuberculin, and 8,202 sheep, 13 swine, and 14 goats were inspected.

For shipment to other countries, 175 horses and 220 mules were tested with mallein; the tuberculin test was applied to 1,410 cattle, and inspections were made of 7 sheep, 44 swine, and 2 goats.

### TUBERCULOSIS ERADICATION DIVISION

The progress made in eradicating tuberculosis under the cooperative plan in effect between the bureau and the 48 States has been highly satisfactory. This work is conducted under the direction of J. A. Kiernan, chief.

An average of 211 regularly employed bureau veterinarians were engaged in the work under the supervision of the inspectors in charge of 44 field offices. The livestock sanitary officials of the respective States employed an average of 267 veterinarians, including a limited number employed by municipalities. In addition, approximately 290 regularly employed veterinary inspectors were engaged by the many counties under the intensive area plan. In all there were 768 veterinarians engaged in the work regularly throughout the year. As in previous years, the county veterinarians showed the most marked increase.

Appropriations for the year, both State and Federal, were increased over the preceding fiscal year. The Federal appropriation was \$3,560,000, of which \$982,000 was allotted for operating expenses and \$2,578,000 for indemnifying owners of condemned cattle. This was an increase of approximately

\$150,000 for indemnity purposes over the previous year. The combined State appropriations were approximately \$10,000,000. As a result of this increase of funds the number of cattle tested was 24 per cent more than the preceding year. The general plan of the work, including eradication of tuberculosis under the accredited-herd plan, the area plan, the eradication of the disease from swine, the investigations relative to interstate shipment, and tuberculosis in fowls, was continued.

### ACCREDITED TUBERCULOSIS-FREE HERDS

Although preference was given to the area project, tuberculin testing under the accredited-herd plan was conducted in all States. At the conclusion of the fiscal year there were listed as fully accredited 96,392 herds, containing 1,577,087 cattle, an increase of 24,009 herds, containing 302,024 cattle. In addition, 1,304,432 herds, containing 10,658,259 cattle, passed one test in the process of becoming accredited. This was an increase of 382,674 herds and 2,610,719 cattle. The total herds and cattle under supervision at the end of the fiscal year numbered, respectively, 1,556,366 and 15,131,345. At the end of the year there were on the waiting list 434,636 herds, containing more than 3,994,192 cattle.

In connection with this and the area eradication work, reported later, the tuberculin test was applied to 774,728 herds, containing 8,650,780 cattle, of which 323,084 cattle, or 3.7 per cent, were condemned as diseased. Table 16 shows by years the number of cattle tested, the number and per cent of reactors, and the number of accredited and once-tested herds and cattle.

TABLE 16.—*Progress of work of establishing accredited herds free of tuberculosis*

Fiscal year	Cattle tested <sup>1</sup>	Number reactors	Per cent reactors	Accredited <sup>2</sup>		Passed one test <sup>2</sup>	
				Herds	Cattle	Herds	Cattle
1918.....	134,143	6,544	4.9	204	6,945	883	22,212
1919.....	329,878	13,528	4.1	782	19,021	6,535	117,243
1920.....	700,670	28,709	4.1	3,370	82,986	16,599	197,577
1921.....	1,366,358	53,768	3.9	8,201	193,620	49,814	643,233
1922.....	2,384,236	82,569	3.5	16,216	363,902	161,533	1,548,183
1923.....	3,460,849	113,844	3.3	28,526	615,156	312,281	2,724,497
1924.....	5,312,364	171,559	3.2	48,273	920,370	529,018	4,772,836
1925.....	7,000,028	214,491	3.1	72,383	1,275,063	921,758	8,047,540
1926.....	8,650,780	323,084	3.7	96,392	1,577,087	1,304,432	10,658,259

<sup>1</sup> The total number of cattle tested during the period from 1918 to 1926, inclusive, is 29,339,306, with 1,008,096 reactors, or 3.4 per cent.

<sup>2</sup> The totals for accredited herds and herds having passed one test are cumulative from year to year.

Figures reported by the field offices show that during the fiscal year 1926 accredited veterinarians under this plan tested 43,921 herds, containing more than 788,995 cattle, an increase of 34 per cent over the preceding year.

In connection with the tuberculin testing, a survey was made to ascertain the number of towns and cities in the United States which had municipal ordinances requiring tuberculin testing of cattle furnishing milk for consumption in their communities. On May 1, 1926, it was ascertained that there were 1,249 such cities (minus records from one State), and that all of these were, with the exception of approximately 1 per cent, being fairly well enforced. This is an indication of the interest of the Nation in securing milk or dairy products from healthy cattle.

As an indication of the trend of the work, it is interesting to note that in Hawaii and Alaska considerable numbers of cattle were tested in cooperation with the Federal bureau. A report from Hawaii shows that there were 12,468 cattle tested, with 272, or 2.2 per cent reactors. In Alaska the bureau representative tested 666 cattle, with 23, or 3.5 per cent, reactors.

Of further interest in connection with the tuberculin testing under both accredited and area plans was a survey to show the present estimated extent of the disease. Similar surveys were made as of May 1, 1922, and 1924. The 1922 estimated per cent of infection was 4 per cent; the 1924 was 3.3 per cent. A more recent survey showed the probable extent of the

disease as 2.8 per cent. The most interesting phase of this study shows that more than 86 per cent of the area of the United States is either in the modified accredited area class, or contains less than 3 per cent of infection in the cattle. This territory contains approximately 80 per cent of the cattle, and practically all the infection is contained in the 13 per cent of territory reported as showing 3 per cent or more of infection in the cattle. This reduction in the percentage of the disease is attributed to the intensive area work which has been conducted in many parts of the United States.

#### ERADICATION OF TUBERCULOSIS FROM AREAS

Rapid progress was made in the eradication of tuberculosis from cattle within circumscribed areas. About 77 per cent of the total number of cattle tested in the whole work of tuberculosis eradication were tested under this plan. Results continue to demonstrate the value and efficiency of the plan. At the close of the fiscal year 756 counties had engaged in eradication under this plan. This is an increase of 165 counties, or 28 per cent over the reported number for the preceding year. The counties spent approximately \$1,067,000 on such work, an increase of more than \$367,000. Many State legislatures enacted legislation improving existing laws relative to area work, or passed entirely new legislation looking to more rapid progress. The status of the area work is shown in Table 17.

TABLE 17.—*Status of tuberculosis eradication from county areas at close of fiscal year ended June 30, 1926*

State	Counties completing one or more tests of all cattle <sup>1</sup>	Counties intensively engaged in testing	Total counties engaged	Modified accredited areas	Cattle tested during year	State	Counties completing one or more tests of all cattle <sup>1</sup>	Counties intensively engaged in testing	Total counties engaged	Modified accredited areas	Cattle tested during year
Alabama.....	0	3	3	0	751	Nebraska.....	17	9	26	9	383,614
Arizona.....	0	11	11	0	35,404	Nevada.....	0	12	12	0	12,460
California.....	2	1	3	2	46,896	New Hampshire.....	0	5	5	0	22,067
Colorado.....	0	2	2	0	4,817	New Mexico.....	0	15	15	0	6,924
Delaware.....	0	1	1	0		New York.....	6	37	43	2	560,309
District of Columbia.....	1	0	1	0	221	North Carolina.....	62	13	75	62	99,131
Florida.....	4	0	4	3	3,037	North Dakota.....	14	11	25	14	175,522
Georgia.....	2	0	2	0	11,932	Ohio.....	12	25	37	5	298,932
Idaho.....	7	10	17	6	55,269	Oregon.....	10	10	20	3	143,873
Illinois.....	1	65	66	1	669,984	Pennsylvania.....	4	38	42	4	323,699
Indiana.....	17	21	38	6	240,851	South Carolina.....	0	2	2	0	5,468
Iowa.....	26	26	52	19	1,097,795	South Dakota.....	3	0	3	1	106,831
Kansas.....	14	0	14	13	137,840	Tennessee.....	3	1	4	3	36,208
Kentucky.....	28	10	38	0	82,128	Utah.....	2	15	17	1	64,377
Maine.....	1	15	16	1	22,536	Vermont.....	0	0	0	( <sup>3</sup> )	19,786
Maryland.....	0	6	6	0	77,031	Virginia.....	2	1	3	0	10,880
Michigan.....	34	14	48	27	439,156	Washington.....	3	29	32	0	133,399
Minnesota.....	10	0	10	4	458,045	West Virginia.....	2	2	4	2	26,921
Mississippi.....	4	0	4	0		Wisconsin.....	33	13	46	7	817,893
Missouri.....	3	3	6	3	17,913	Total.....	330	427	757	198	6,661,732
Montana.....	3	1	4	( <sup>2</sup> )	7,732						

<sup>1</sup> Including modified accredited areas.<sup>2</sup> Part of one county.<sup>3</sup> Four towns.<sup>4</sup> Figures not separated from accredited-herd testing.

## STATISTICS OF SLAUGHTER AND INDEMNITY

Increased efforts were made during the year to conserve indemnity funds by obtaining the maximum salvage possible for animals slaughtered as a result of their condemnation for tuberculosis. Bureau agents visited

many public stockyards, packing houses, and commission agencies relative to this phase of the work with the idea of obtaining the most economical administration possible. The results are shown in Table 18.

TABLE 18.—*Cattle slaughtered, appraised value, indemnity allowed, and salvage realized in work of tuberculosis eradication*

State	Cattle slaughtered	Average appraisal per head	State indemnity	Federal indemnity	Average State indemnity per head	Average Federal indemnity per head	Average salvage per head
Alaska.....	34	\$164.65	\$3,824.20	\$825.00	\$112.48	\$24.27	\$3.30
Arizona.....	1,239	91.90	27,733.71	27,733.71	22.38	22.38	18.42
Colorado.....	278	86.44	5,339.63	5,339.63	19.21	19.21	21.58
Connecticut.....	4,432	69.77	119,437.01	58,962.38	26.95	13.30	28.74
Delaware.....	1,306	71.71	30,714.94	22,836.87	23.52	17.49	18.69
Florida.....	346	28.46	4,540.92	2,274.64	13.12	6.57	8.70
Hawaii.....	178	212.89	8,650.00	4,340.25	48.60	24.38	54.28
Idaho.....	145	41.06	1,250.86	1,250.86	8.63	8.63	15.75
Illinois.....	20,563	74.26	319,785.72	319,785.72	15.55	15.55	29.89
Indiana.....	3,786	93.86	83,625.13	74,993.98	22.09	19.81	27.05
Iowa.....	12,234	78.20	152,212.53	152,212.53	12.44	12.44	29.62
Kansas.....	1,256	77.59	21,151.47	20,527.54	16.84	16.34	27.20
Kentucky.....	424	65.77	10,390.89	5,889.53	24.51	13.89	17.26
Maine.....	604	93.71	35,199.30	11,294.02	58.28	18.70	12.63
Maryland.....	7,357	76.13	141,344.18	141,344.18	19.21	19.21	18.59
Massachusetts.....	4,115	119.05	110,008.36	110,008.36	26.73	26.73	21.00
Michigan.....	3,983	80.37	131,982.55	58,673.58	33.14	14.73	25.91
Minnesota.....	13,165	57.86	265,372.86	89,988.34	20.16	6.84	25.38



TABLE 18.—*Cattle slaughtered, appraised value, indemnity allowed, and salvage realized in work of tuberculosis eradication—Continued*

State	Cattle slaughtered	Average appraisal per head	State indemnity	Federal indemnity	Average State indemnity per head	Average Federal indemnity per head	Average salvage per head
Mississippi.....	1	\$35.00	\$8.33	\$8.33	\$8.33	\$8.33	\$1.29
Missouri.....	81	138.58	2,297.74	2,297.74	28.37	28.37	24.15
Montana.....	281	54.41	10,891.59	4,533.21	38.76	16.13	5.26
Nebraska.....	4,229	81.45	56,473.12	56,473.12	13.35	13.35	28.39
Nevada.....	78	71.47	1,640.82	1,404.43	21.04	18.00	14.54
New Hampshire.....	2,977	73.27	99,071.09	53,034.97	33.28	17.81	19.35
New Jersey.....	2,570	102.32	61,269.49	59,178.26	23.84	23.03	26.24
New Mexico.....	69	46.05	1,060.74	1,060.74	15.36	15.36	.00
New York.....	16,446	101.64	970,578.69	255,010.76	59.02	15.51	25.17
North Carolina.....	494	104.00	12,455.13	12,455.13	25.21	25.21	11.82
North Dakota.....	2,725	48.35	22,849.44	22,849.44	8.39	8.39	23.03
Ohio.....	5,793	103.16	130,000.00	130,000.00	22.44	22.44	27.13
Oklahoma.....	64	71.21	1,412.99	1,049.66	22.08	16.40	19.29
Oregon.....	1,390	86.32	18,529.43	18,529.43	13.33	13.33	14.73
Pennsylvania.....	24,800	94.15	972,971.12	199,921.73	39.23	8.06	17.82
Rhode Island.....	435	92.19	18,068.50	6,693.94	41.54	15.39	28.65
South Carolina.....	112	82.30	2,176.90	2,176.90	19.44	19.44	23.97
South Dakota.....	2,476	79.42	38,305.57	38,305.57	15.47	15.47	27.25
Texas.....	206	116.33	5,008.46	5,008.46	24.31	24.31	14.84
Utah.....	613	71.39	10,150.58	10,150.58	16.56	16.56	20.97
Vermont.....	4,475	74.48	66,322.63	66,322.63	14.82	14.82	15.09
Virginia.....	441	93.96	12,145.55	8,993.84	27.54	20.39	17.66
Washington.....	2,749	99.96	65,420.66	65,420.66	23.80	23.80	19.60
West Virginia.....	653	86.13	21,867.11	11,594.33	33.49	17.76	15.98
Wisconsin.....	15,119	100.06	248,998.18	248,998.18	16.47	16.47	29.37
Wyoming.....	33	64.55	463.84	463.84	14.06	14.06	.50
Total.....	164,755	85.33	4,323,001.96	2,390,217.00	26.24	14.51	24.64

<sup>1</sup> Salvage paid to State.

#### ERADICATION OF TUBERCULOSIS FROM SWINE AND FOWLS

The problem of eradicating tuberculosis from swine has continued to be especially interesting in view of the premium being paid by a number of packers for swine from areas officially declared to be free from the disease under the area plan. Reports from many of the modified accredited areas indicate that swine owners have realized substantial sums in this way.

The testing of breeding herds of swine and the tracing of new centers of infection on the basis of slaughterhouse reports were continued. Investigations regarding the source of infection of tuberculosis in swine were also continued with a view to determine to what extent such infection might be traced to tuberculous fowls. The question of fowl tuberculosis continues to be an important phase of the tuberculosis-eradication problem. A survey begun in 1925 and continued during the fiscal year 1926 covered the inspection of approximately 157,950 poultry flocks, containing about 14,000,000 fowls, in 40 States. Approximately 10,000 of these flocks were found to be infected with tuberculosis. These inspections were made in the

course of the routine testing of cattle by regularly employed veterinary inspectors. The procedure in brief is as follows: Inspection of the flock for "light" birds; study of the history as given by the owner; autopsies on suspected birds, followed by advice relative to control measures, including the slaughter of infected birds; culling or total destruction of the flocks; tuberculin testing in flocks sufficiently valuable to make it economically worth while; and proper sanitation.

#### REGULATION OF INTERSTATE MOVEMENT OF CATTLE

Most of the tuberculin testing of cattle for interstate movement was done by approved veterinary practitioners, of whom 8,908 are on the list approved by State and Federal officials. These men tested for interstate shipment 29,924 herds, containing approximately 355,836 cattle, of which 0.7 per cent reacted. This is an increase of about 76,000 over the number of cattle tested in the fiscal year 1925. Bureau inspectors tested at public stockyards 72,837 cattle, of which 1,513, or 2 per cent, reacted. Permits were issued for the interstate movement of 82,067 known reactors for immediate slaughter.

## TUBERCULIN TESTING

Tuberculin tests during the year were made by the various methods, as follows:

Test employed	Cattle tested	Reactors found	Per cent reactors	Test employed	Cattle tested	Reactors found	Per cent reactors
Intradermic.....	7,370,894	242,819	3.3	Combination of tests..	1,266,077	80,596	6.3
Subcutaneous.....	3,216	116	3.6	Total.....	8,630,965	323,625	3.7
Ophthalmic.....	778	94	12.1				

Of the cattle reported tested during the year, about 22 per cent were tested by bureau inspectors and about 78 per cent by State, county, municipal, and accredited practicing veterinarians.

A further study was made of cases in which no visible lesions of tuberculosis were noted on post-mortem examination of slaughtered reacting cattle. About 56 per cent of such cases were found to have originated in herds known to harbor infection.

The average cost of testing by bureau field veterinarians, including salaries and expenses, but not office expenses or salaries of supervising officers, was 34 cents a head for 1926, which is 1 cent a head more than the preceding year. The slight increase is due partly to salary adjustments and partly to the lessened volume of testing done by bureau veterinarians, who have been called on to give more supervision to the work of county and accredited veterinarians. The average cost of testing by all field agencies, including State and county organizations, was lessened.

#### CONFERENCES AND PUBLICITY ON TUBERCULOSIS ERADICATION

The annual Eastern States conference on tuberculosis was held at Burlington, Vt., June 22 and 23, 1926, and was largely attended by bureau and State officials, practicing veterinarians, livestock owners, representatives of breeders' associations, public-health officials, county agents, and others. Numerous State and local meetings of veterinarians and livestock owners were also attended and addressed by representatives of the Tuberculosis Eradication Division.

A wide distribution of department literature on tuberculosis continued, including a new poster on tuberculosis.

Several small exhibits were also prepared and distributed for use at county fairs, local meetings, and other places.

#### TICK ERADICATION DIVISION

The Tick Eradication Division, under the direction of R. A. Ramsay, chief, continued its cooperation with State and county authorities in 10 Southern States in suppressing splenic or Texas fever of cattle and in eradicating the tick which transmits that disease.

#### TICK ERADICATION

The field activities were continued under the direction of 9 field stations which at the close of the fiscal year had a total field force of 270 veterinarians and other employees working in cooperation with 304 State inspectors and 390 county employees.

Under the supervision of the co-operating forces 16,683,285 inspections or dippings of cattle were conducted and more than 16,000 dipping vats were used in these official dippings. The bureau continued to urge the advisability of giving special attention to the completion of tick eradication in areas which had been released from Federal quarantine but in which a small amount of infestation remained.

During the active tick-eradication season of 1925 the ticks were completely eradicated from 72 additional released counties; and during the fiscal year the following areas were released from Federal quarantine: 2 counties and part of 1 county in Alabama; 2 counties and parts of 2 counties in Arkansas; 6 counties and parts of 4 counties in Florida; 7 counties in North Carolina; and 1 county and parts of 2 counties in Oklahoma. During the same period the follow-

ing areas were requarantined: Part of 1 county in Alabama; 3 parishes and part of 1 parish in Louisiana; and parts of 4 counties in Texas. The removal of the quarantine from the last 7 counties in North Carolina, December 10, 1925, marked the release

of the entire State from Federal quarantine.

Table 19 shows the progress made in tick eradication since its beginning, in 1906, and gives the status of the work at the close of the fiscal year 1926.

TABLE 19.—*Tick-eradication results, July 1, 1906, to June 30, 1926*

State	Counties quarantined		Counties released to June 30, 1926	Released counties tick-free			
	July 1, 1906	June 30, 1926		Nov. 1, 1922	Nov. 1, 1923	Nov. 1, 1924	Nov. 1, 1925
Alabama.....	67	5	62	15	26	41	49
Arkansas.....	75	34	41	16	21	34	31
California.....	15	0	15	15	15	15	15
Florida.....	66	54	12	3	3	1	7
Georgia.....	158	0	158	101	119	138	149
Kentucky.....	2	0	2	2	2	2	2
Louisiana.....	64	41	23	3	3	4	4
Mississippi.....	82	23	59	37	47	54	47
Missouri.....	4	0	4	4	4	4	4
North Carolina.....	73	0	73	40	46	53	65
Oklahoma.....	61	4	57	35	47	49	52
South Carolina.....	46	2	44	29	35	36	40
Tennessee.....	42	0	42	41	41	42	42
Texas.....	198	94	104	44	49	56	69
Virginia.....	31	4	27	(1)	(1)	(1)	25
Total.....	984	261	723	385	458	529	601

<sup>1</sup> Inactive from Nov. 1, 1922, to Nov. 1, 1924.

#### SHIPMENTS FROM QUARANTINED AREAS

There were 606,094 southern cattle shipped from the quarantined areas to market centers for immediate slaughter during the fiscal year 1926. The status of southern-cattle shipments for immediate slaughter, which was specifically authorized by a provision in the act of Congress passed in 1884, before the cattle tick was incriminated as the carrier of Texas or tick fever, was changed near the close of the year by the act of Congress approved June 28, 1926. This act repeals the provision in the 1884 law and provides that until May 1, 1928, cattle infested with or exposed to cattle-fever ticks may be shipped in interstate commerce for immediate slaughter after one dipping in accordance with such regulations as the Secretary of Agriculture may prescribe. On and after May 1, 1928, only tick-free cattle will be permitted in interstate commerce for any purpose.

In the movement of this class of cattle from the quarantined area, for purposes other than slaughter, 213,946 head were inspected or dipped in the field, for which 4,859 certificates were issued authorizing their interstate movement. At public stockyards

88,234 cattle were dipped and 936 certificates issued authorizing their movement as noninfectious.

#### MOTION PICTURES IN STIMULATING TICK ERADICATION

The use of motion pictures as a means of showing proper methods to be followed in tick eradication and in molding favorable sentiment for this work, was continued with gratifying results with two portable motion-picture outfits. Exhibitions were given in the rural districts of the tick-infested sections in Arkansas, Alabama, Louisiana, Florida, Mississippi, Texas, and Oklahoma. There were 481 exhibitions given to rural audiences aggregating 80,653 persons.

#### DIVISION OF HOG-CHOLERA CONTROL

The work of controlling and reducing hog cholera was continued through the Division of Hog-Cholera Control under U. G. Houck, chief. In general, the swine industry of the United States did not suffer unusually from hog cholera in the last fiscal year. The losses from the disease, which have been steadily reduced since 1913, remained at a low figure during the year. Although there was an increase



over the previous year in the number of outbreaks reported, the situation did not present an alarming aspect as in former years. In fact, with the proper amount of supervision, surveys, and continued advice regarding immunization and sanitation, hog cholera is no longer viewed as a limiting factor in swine raising.

#### SUMMARY OF CONTROL WORK

During the year services equivalent to the entire time of 33 veterinarians were rendered the swine industry in 32 States in protecting it against losses from hog cholera. In the discharge of their duties in hog-cholera work, bureau inspectors attended 813 meetings and addressed 594. These meetings were attended by 53,238 persons interested in the control of hog cholera. Persons interviewed on the subject of hog-cholera prevention, such as farmers, stock raisers, bankers, merchants, editors, practicing veterinarians, and others, numbered 97,462. A total of 7,163 visits to farms were made to survey conditions as they pertained to hog cholera. Investigations in answer to calls for assistance were made in 14,350 instances, in the course of which 2,355 post-mortem examinations were held and 1,772 cases of hog cholera diagnosed. From all sources there were reported to bureau veterinarians 4,291 outbreaks of hog cholera during the year.

Bureau inspectors assisted local veterinarians in the immunization of 11,376 hogs, the object being to impress these practitioners with the necessity for proper diagnosis of disease in swine herds, correct technic in the application of the treatment, and the importance of cleanliness in the handling of instruments, serum, and virus. At demonstrations there were treated 85,381 hogs, the total attendance at these demonstrations being 11,565. Quarantine was applied on 843 premises, and 350 such places were cleaned and disinfected. In sections where the services of veterinary practitioners were not available, 17 laymen were trained to administer the serum treatment against hog cholera.

#### DIVISION OF VIRUS-SERUM CONTROL

The administrative and regulatory work under the virus-serum-toxin act of 1913 was continued by the Division of Virus-Serum Control under the direction of D. I. Skidmore, chief. The work consisted of the issuance of license to establishments producing veterinary biologic products intended

for sale in interstate commerce, the inspection of such establishments as to sanitary conditions and methods of production, the supervision of the production and the testing of products, and the certification of products for exportation. It also included the issuance of permits for the importation of biologic products from abroad, and their inspection at ports of entry.

#### WORK AT LICENSED ESTABLISHMENTS

At the close of the year 88 establishments in 60 cities and towns in 20 States were operating under license and inspection, as compared with 91 at the end of the preceding year. Fifty-two of the establishments were engaged in producing only anti-hog-cholera serum and hog-cholera virus, 30 in producing other biologic products, and 6 in producing both classes of products. Among the products were antisera, aggressins, bacterins, vaccines, tuberculin, and mallein. Inspectors of the bureau supervised the production, and testing of anti-hog-cholera serum and hog-cholera virus. They also conducted tests to determine whether these products were preserved properly, and made periodical visits of inspection to establishments producing other products. Cultures of organisms and samples of products were collected for examination on many of these visits.

An average of 87 inspectors was maintained in the field. They examined and admitted into licensed establishments 232,523 hogs and 1,449 calves. Fifty-two hogs were rejected at the time they were offered for admission and 9,909 hogs were rejected after admission because of conditions which made them unsuitable for the production or testing of biologic products. The inspectors supervised 3,354 potency and 2,700 purity tests of anti-hog-cholera serum and 57 and 2,219 tests of hog-cholera virus for virulence and purity, respectively. They also collected a total of 153 samples (exclusive of anti-hog-cholera serum and anti-hog-cholera virus) of products produced by licensed establishments or materials used in preparing these products. Sixty-three of these samples or materials were subjected to laboratory examination, of which 45 were found to be satisfactory and 18 unsatisfactory or contaminated. The remaining 90 samples in this collection represented preserving solutions and biologic products examined to determine their phenol content, of which 86 were satisfactory and 4 unsatisfactory.

In addition, 8 special animal tests of products were supervised by inspectors at establishments, 6 of these being found satisfactory, and the results of the other 2 being either unsatisfactory or inconclusive. Fifty-nine strains of organisms intended for use in the preparation of biologic products by licensed establishments were collected and subjected to laboratory examination. Fifty-one of these were found to be satisfactory and 8 unsatisfactory or contaminated.

#### OUTPUT OF BIOLOGIC PRODUCTS

The quantity of anti-hog-cholera serum produced by licensed establishments was 468,096,257 cubic centimeters, of which 301,303,014 cubic centimeters was ordinary serum and 166,794,243 cubic centimeters clarified serum. The quantity of simultaneous hog-cholera virus produced was 37,600,650 cubic centimeters, while the production of hyperimmunizing virus amounted to 94,855,278 cubic centimeters and inoculating virus 406,043 cubic centimeters, making the total quantity of virus 132,861,971 cubic centimeters.

The production of other biologic products by licensed establishments aggregated 26,323,893 doses, classified as follows: Bacterins, 8,062,057; vaccines and viruses, 6,175,925; aggrassin, 7,218,220; tuberculin, 3,075,912; avian tuberculin, 290,490; mallein, 95,160; antisera and sera, 1,406,129.

#### PRODUCTS REJECTED

A total of 4,082,608 cubic centimeters of anti-hog-cholera serum was destroyed as unfit for use for the treatment of animals. Of this quantity 2,897,244 cubic centimeters was derived from animals affected with diseases such as tuberculosis, pneumonia, septicemia, etc., and the remaining 1,185,364 cubic centimeters was destroyed because of contamination in the process of manufacture or on account of other conditions which rendered the product unfit for use. The total quantity of simultaneous virus destroyed was 1,478,578 cubic centimeters, of which 426,960 cubic centimeters was destroyed on account of being derived from diseased animals and 1,051,618 cubic centimeters because of contamination and other undesirable conditions. The total quantity of hyperimmunizing virus destroyed was 2,964,937 cubic centimeters, of which 2,662,322 cubic centimeters was destroyed on account of disease and 302,615 cubic centimeters on account

of contamination and similar conditions.

#### EXPORTS AND IMPORTS OF BIOLOGIC PRODUCTS

The exportation of biologic products continued to increase. Four hundred and sixty-seven certificates were issued to accompany shipments to 22 foreign countries.

At the close of the year permits were outstanding which enabled the importation into the United States of products from three different foreign producers. These permits allowed the importation of anthrax vaccine, anti-blackleg serum, blackleg vaccine, blackleg cultural aggrassin, blackleg bacterin with a number of other bacterins, polyvalent serum, and tuberculin. The Treasury and Post Office Departments cooperate with the bureau in preventing the importation of products of a biologic character except in the regular manner and under permit. Bureau inspectors at ports of entry regularly examine all packages of such products before they are released for distribution in this country. A number of products not eligible for importation were either denied entry or destroyed during the year.

#### PATHOLOGICAL DIVISION

The Pathological Division, under the direction of John S. Buckley, chief, has continued the investigation of animal diseases, particularly the infectious diseases and those caused by poisonous plants.

#### DIAGNOSIS AND CONTROL OF DISEASES GLANDERS

Cooperative work for the control and eradication of glanders in the various States was continued. The complement-fixation test was applied to 194 samples of serum from animals suspected of being affected with or exposed to the disease, 14 of which gave positive reactions.

#### DOURINE

In the course of the campaign for the control and eradication of dourine 4,845 samples of blood serum from horses in districts where dourine is present or suspected of being present were subjected to the complement-fixation test, and 405, or approximately 8 per cent, gave positive reactions.

#### TESTING ANIMALS FOR IMPORT

Blood serum from 77 horses offered for import was subjected to the com-



plement-fixation test for glanders and trypanosomiasis before admission. The same test was also applied to 26 camels for trypanosomiasis, 2 of which gave positive reactions.

#### BOVINE INFECTIOUS ABORTION

During the latter part of the preceding fiscal year 20 calves were used to determine whether calves can be immunized against infectious abortion in such a manner as to enable them to resist the disease after they become mature and are bred.

Previous experimental work has very clearly demonstrated that the vaccination of heifers with suspensions of *Bacterium abortus* at near breeding age confers a reasonably satisfactory immunity. In the event that vaccination during calthood proves to be as successful as during a later period, then some of the undesirable features associated with vaccination will be overcome and the method may be practiced to better advantage, especially under range or semirange conditions. The vaccinated calves have made good growth since treated. Although vaccination resulted in the development of marked agglutination reactions for a brief period, the reactions have, with but one exception, either disappeared after a few months or subsided to such a degree as to suggest the absence of permanent infection.

Further studies have been made of the practicability of efforts to eradicate the disease from herds both by the segregation and elimination of reactors to the agglutination test. Owners of herds appear to be seldom equipped with facilities for maintaining a reacting and nonreacting herd in such a manner as wholly to prevent the transference of infection. The elimination of reactors, moreover, is regarded by many herd owners as entailing too great a financial loss, particularly when assurance can not be given that a single test will detect all or nearly all the animals that are harboring the infection.

There was prepared during the year for distribution a mimeographed pamphlet entitled, "Infectious Abortion of Cattle," which is a brief description of present knowledge concerning the disease and methods of prevention and control.

#### TESTING BIOLOGICAL PRODUCTS

In connection with the enforcement of the virus-serum-toxin law this division continued the examination of bio-

logical products prepared under United States veterinary licenses. Cultures of the microorganisms entering into the productions of these products were also determined bacteriologically.

A number of products were subjected to laboratory examination, which included potency and safety tests whenever such were required.

#### TUBERCULOSIS

In view of the apparent detoxicating or desensitizing effect of formaldehyde on certain bacterial products, such as diphtheria toxin and blackleg-culture vaccines, experiments were begun to determine the effects of formaldehyde on tubercle-bacilli cultures intended for antigens in the production of immunity. An initial experiment was made, in which three yearling heifers were given repeated injections of formaldehyde-treated tubercle cultures. Two untreated animals of the same age were reserved as controls.

Exposure of these animals to virulent tubercle culture resulted in the development of extensive lesions of tuberculosis in the untreated cattle, whereas slight or no lesions could be found in the treated ones.

These promising results seem to justify further investigation looking to the determination of the least number of injections of this antigen that will stimulate an immunity sufficient to ward off natural infections of tuberculosis. Attempts are being made to produce a hyperimmune serum in horses by the use of a similarly prepared antigen.

#### "FORAGE POISONING" OF HORSES

In connection with studies on forage poisoning a number of visits were made during the year to premises where this disease had made its appearance and where assistance was requested by the owner and attending veterinarian. In addition to rendering such assistance, the bureau's investigators collected samples of the suspected feeds and brought them to the division laboratories for bacteriological examination.

One sample of hay yielded cultures of *B. botulinus*, type B. The same sample of hay, when fed to a horse, produced symptoms indistinguishable from forage poisoning, due to the contained toxin. Death overtook the animal in approximately one week.

Hyperimmune botulinus serum is being produced in mules with a view to testing, under proper control, its value in preventing natural cases of forage poisoning.



### HISTOLOGICAL STUDIES

Much time was occupied with routine pathological and bacteriological diagnostic work which frequently necessitates histological studies from tissue sections.

Such studies are made also in cooperation with other divisions and bureaus. In this connection, one piece of work for the Bureau of Biological Survey consisted of the microscopical study of more than 20 livers of foxes which had been treated experimentally with tetrachlorethylene for hookworm diseases. A description of the histological findings in these cases will be included in a paper to be published by the Bureau of Biological Survey.

Cooperative work is also being done in making histological studies of the udders of cows for the Bureau of Dairy Industry. The more important phase of this work has to do with the productivity of the mammary glands in the various ages and types of animals.

### RESEARCH ON DISEASE PROBLEMS

Bacteriological investigations of the cause of certain peculiar nodular splenic lesions of swine have been continued and there has been isolated second-time cultures of actinomyces from the lesions.

Work has continued on the investigation of the Montana sheep disease known as progressive pneumonia, and several experimental inoculations of sheep have been made with cultures obtained from spontaneously affected animals. The etiological factor continues to be baffling.

A study of leukemia of cattle has been undertaken. A typical case of the disease in a cow offered an unusual opportunity for a study of the condition. Blood counts and other observations with regard to the blood have been made on the affected animal at different times. After slaughter of the diseased animal, bacteriological and histological studies were made of the various tissues, the bacteriological findings being negative. Bovine, ovine, and small-animal inoculations have been made with blood and other tissues from the leukemic animal.

### TESTS OF GLANDS FROM COWS THAT HAVE REACTED TO TUBERCULIN

During the year microscopic examination was made of glands from 153 cattle that had reacted to tuberculin test but in whose carcasses no visible lesions of tuberculosis were discovered

at the time of slaughter. Of these 59 were found to contain acid-fast microorganisms, and 94 were without such evidence.

### INVESTIGATIONS IN AVIAN PATHOLOGY

Many poultry carcasses from numerous localities adjacent to Washington have been autopsied. Among the principal diseases observed were roup, diphtheria, pox, coccidiosis, bacillary white diarrhea, and typhoid.

Experiments in the possibility of heredity of avian tuberculosis are being continued. An interesting outbreak of an obscure disease combining ophthalmia with paralytic symptoms was studied. Bacterial infection, nutritional deficiency, and botulism were definitely eliminated.

An extensive experiment in autogenous vaccination for roup produced favorable results.

### RABIES

During the fiscal year 289 cases were examined for rabies, but in two cases the brain was so decomposed that no microscopic examination was possible. Of this number, 146 proved to be positive. The cases were greatly in excess of the average for the three previous years, and came principally from the District of Columbia and the surrounding counties in Maryland and Virginia.

### ZOOLOGICAL PARK ANIMALS

During the year there were received 58 specimens of wild animals from the National Zoological Park for post-mortem examination. Autopsy revealed the cause of death in all but five cases. In addition the apparent reason for the death of 17 birds was determined in all but one instance.

### BRANCH LABORATORIES

At the pathological laboratory, Omaha, Nebr., there were received in all 1,093 specimens, of which 823 were specimens of glands and tissues, other than lymphatic glands, from so-called no-lesion reactors. Of these 823 specimens 740 gave negative and 83 positive results. The figures show that the positive findings were almost exactly 10 per cent of the entire number of reactors. The 270 other specimens were of miscellaneous character.

As in former years, the work conducted at the branch pathological laboratory at Chicago, Ill., consisted largely in making diagnoses of diseased conditions in animals slaughtered under Federal meat inspection

at Chicago and other cities in the Middle West where Federal inspection is maintained. The specimens received for diagnosis were of a wide variety.

Two specimens were received which, owing to their rare occurrence, deserve special mention. One of these was found to be a multiple papillary adenoma in the lungs of a young cow, 18 months old. The cow, when slaughtered, was in prime condition. It was estimated that there were between 400 and 500 individual tumors distributed throughout the lungs, ranging in size from a small pea to about 2 inches in diameter. No tumorlike growths were found in any of the other organs in the body. A search was also made of the lymph nodes draining the lungs for evidence of metastases, but none were found. The epithelial cells forming the principal part of these tumors were of the ciliated type, thus showing that the tumors had their origin in the bronchioles.

The other rare specimen was a congenital cystic condition of the liver in a cow about 12 years of age. The liver was about twice its normal size, very dark in color, and contained a large number of cysts which varied in size from a pinhead to one-half inch in diameter. The liver substance was so thickly studded with these cysts that those appearing on a cut surface numbered about 25 to the square inch. These cysts contained a thick, semi-transparent, mucoid substance, which was slightly gray. On microscopic examination it was found that they were enlarged bile ducts in the interlobular triangles. This is the second case of the kind encountered since the laboratory was established, in 1906.

During the year additional investigations were made relative to the so-called tuberculous skin lesions in cattle.

An article entitled "Parasitic Nodules Resembling Tuberculosis in the Lungs of Swine" was published, based on original work conducted in the laboratory as well as on the killing floors of the packing houses. This article is of importance to meat inspection, because it points out the similarity of tuberculosis and parasitic nodules in the lungs of swine.

Assistance was rendered to the health commissioner of Chicago Heights, Ill., in making a diagnosis of an outbreak of trichinosis. The nature of the outbreak of the disease was somewhat puzzling, although the physicians in attendance suspected ty-

phoid fever. Two deaths had occurred and several people had become quite ill. The cause of the trouble was found to be due to the eating of raw pork of a home-slaughtered hog infested with trichinae.

Many samples of milk used in the manufacture of oleomargarine were examined during the year to determine its fitness for use in this product.

As in former years, a number of museum specimens were prepared and forwarded to the Office of Exhibits, at Washington, D. C., to be used for exhibition purposes, showing the manifestations of diseases in tissues, especially tuberculosis.

In addition to assisting the meat-inspection service, assistance has been rendered to local hospitals, medical colleges, veterinarians, stockmen, and others.

At the branch laboratory, Denver, Colo., 1,384 specimens were received for examination during the 12 months, 214 more than for the previous year.

Increasing demand for assistance on various poultry problems continued. The major project along this line was the making of experimental bacterin for roup and its allied disorders.

The study of anaerobic organisms in horses, cattle, and sheep indicated a large unexplored field in this line of bacteriological endeavor.

Anaerobic organisms are believed to be important factors in lamb-feeding losses in the Rocky Mountain section. Feeding in such a manner as to reduce the amount of dirt consumed with the feed is looked upon as a means of avoiding bacterial contamination; hence, its exclusion by cleanly methods of feeding is believed to be an important factor in controlling death losses. Feeding grain in troughs entirely and keeping cut hay and fodder away from the ground promise good results.

Besides the special problems under consideration, routine diagnoses were made on many kinds of animal tissues. Means of preventing further loss in herds and flocks are suggested to the owners.

The small cost of maintaining this laboratory doubtless saves the livestock interests of this country many hundreds of thousands of dollars yearly; also it assists in acquiring information and data on new remedies and means of combating disease.

#### INVESTIGATION OF POISONOUS PLANTS

Progress in investigations of several harmful plants included studies of: *Asclepias subulata*, a desert milkweed



which has been supposed to have caused considerable losses of sheep in Arizona; *Astragalus nothoxys*, a loco plant of the Southwest; *Chrysothamnus stenophyllus*, a poisonous plant of some importance in regard to sheep in southern Utah; *Karwinskia humboldtiana*, or coyotillo, which is of interest because of its very poisonous character; *Hypericum perforatum*, or St. John's wort, which has long been known as producing serious effects on domestic animals; a lupine from the Lassen National Forest, which proved to be exceedingly poisonous to cattle; *Nicotiana trigonophylla* and *attenuata*, wild-tobacco plants which have caused losses in New Mexico and Arizona (this work is now complete); *Senecio integerrimus*, a Utah plant which has been found to have a rather peculiar effect on certain domestic animals; *Triglochin maritima*, or arrow grass, a rather widely distributed plant which has only recently been thought to be poisonous to domestic animals.

In addition, investigation was made of reported heavy losses of swine in South Dakota which had been kept on the shores of a lake. It was said that the loss occurred at a time when the lake was covered with minute, green algae, which is sometimes spoken of as scum of "bloom of the lake." This was investigated, and in the light of preceding cases it seems probable that the algae were the cause of the loss.

#### CHEMICAL INVESTIGATIONS OF POISONOUS PLANTS

Investigations of the chemical constituents of stock-poisoning plants have been continued. Associated with these studies a series of biochemical investigations has been made to elucidate the course of disease in some cases of poisoning with the hope that such information might make possible the discovery of a remedy. The specific problems worked on and the progress made are as follows:

Gratifying progress has been made in the study of *Eupatorium urticaefolium* and of the sickness it causes in animals. A small quantity of the poisonous principle has been obtained in pure condition and is being studied chemically.

Concurrently with the study of *Eupatorium*, the chemistry of the rayless goldenrod (*Aplopappus heterophyllus*) has been studied. A crystalline substance has been isolated that is undoubtedly the poisonous principle.

In the study of poisonous lupines the principal difficulty has been in obtaining material with which to work. During the year alkaloids were extracted from the following species: *L. wyethii*, *L. decumbens*, *L. luteolus*, *L. perennis*, *L. mutabilis*, and an unnamed species from California. These alkaloids are being purified and studied to determine their identity.

Work on the three toxins of *A. galioides* has been continued. The spasmodic toxin has been isolated in reasonably pure condition. The two glucosidal toxins, however, have so far resisted purification.

Five pounds of berries received in January, 1926, permitted a continued investigation of *Karwinskia humboldtiana*, and from them a crystalline substance that is probably the toxic principle has been isolated. This is in process of purification.

Studies of the blood and urine of animals suffering from "trembles" have been continued. The data demonstrate that poisoning with richweed or with rayless goldenrod is accompanied by an acidosis. This has an important bearing on human medicine from the fact that milk sickness in human beings is caused by the ingestion of milk or butter from cows that have eaten either of these plants.

During the year a number of specimens of tissues, stock salt, and similar materials were analyzed for the detection of poisons. A study of the possible poisonous properties of Japanese honeysuckle, *Lonicera japonica*, was made. This plant is probably harmless to livestock.

#### BIOCHEMIC DIVISION

The work of the Biochemic Division, under M. Dorset, chief, consisted chiefly of laboratory research relative to meat products, investigations concerning hog cholera, studies of dips, disinfectants, and insecticides, and the preparation of tuberculin and mallein.

Much of the research work is too technical to be described in this report, but the results are reported from time to time in technical publications.

#### INVESTIGATIONS OF MEAT AND MEAT PRODUCTS

The chemical and physiological studies of meats and meat food products have been continued, a part of the work as in previous years being done in cooperation with the Animal Husbandry Division.



#### SUPPLEMENTAL VALUE OF MEAT FOR VEGETABLE PROTEINS

In the continued study of the nutritive value of proteins in animal tissues, feeding experiments with albino rats showed that the protein of beef enhances to a remarkable degree the nutritive value of protein in wheat, bolted wheat flour, corn meal, oatmeal, and rice. When each of the above-named products was the sole source of protein in the diet, beef was found to be much more efficient for promoting growth than an equivalent amount of protein in the form of wheat, wheat flour, oatmeal, or navy beans, but when combinations of equal parts of beef and vegetable protein or even one part of beef and two parts of vegetable protein were fed, the mixtures were practically as efficient for promoting growth as when beef protein alone was used, except in the case of navy beans and potatoes. The beef protein did not seem to enhance the value of the protein from the two last-named sources.

#### SUPPLEMENTAL VALUES AMONG ANIMAL PROTEINS

Although most animal proteins have a high biological value, a few of them, including those from tripe and calf sweetbreads, appear to be deficient in essential amino acids. The nutritive value of the proteins in these tissues was very greatly enhanced when they were fed in combination with proteins from beef muscle or beef liver. In the same way the proteins of beef serum which, when fed alone are of rather low biological value, are greatly enhanced in value when fed with the proteins from beef muscle or beef liver.

#### CHEMICAL COMPOSITION AND NUTRITIVE VALUES OF SAUSAGES

Although sausage constitutes an important part of the American dietary, little has been done to determine its nutritive value. A study is in progress to determine the chemical composition, the vitamin content, and the biological values of the proteins of the more important kinds of sausage on the market. A total of 82 samples of sausage have been analyzed, and the determination of the vitamin and protein values is in progress.

#### STUDIES OF RANCIDITY

It was found during the year that the ultra-violet light from the

mercury-arc lamp appears to function in the same manner as, though more effectively than, visible light in promoting rancidity in fats exposed to the air, but like visible light the ultra-violet light appeared to be without effect in either promoting or destroying rancidity in fats when oxygen was excluded. Studies of the effect of the unsaponifiable matter or of cholesterol on the rate of development of rancidity have failed to reveal any definite effect by either.

#### TUBERCULIN AND MALLEIN

The production of tuberculin and mallein for official use by bureau and State inspectors was continued. The total quantity of mallein supplied during the year was 15,285 doses, considerably less than that sent out during the preceding fiscal year. In the case of tuberculin the increased field work in connection with tuberculosis eradication has caused the demand to continue unabated. The year's output of tuberculin was as follows: Subcutaneous tuberculin, 628,500 cubic centimeters; intradermic tuberculin, 2,275,152 cubic centimeters; ophthalmic tuberculin, 3,804,160 disks. The total production during the year amounted to approximately 15,350,000 doses.

Tests of the special synthetic tuberculin referred to in the last report have been continued, with, on the whole, gratifying results. The newer tuberculin appears usually to give a more pronounced and more easily read reaction than the ordinary Koch tuberculin.

During the year the work which has for its object the isolation of the active material from tuberculin and the improvement and standardization of methods of production has continued with gratifying progress.

#### INVESTIGATIONS OF DIPS AND DISINFECTANTS

Routine laboratory examination was made of 249 samples of disinfectants, dips, viruses, serums, and similar products. As in previous years, most of the samples were of disinfectants used by bureau employees in the field to carry out the regulations requiring disinfection of cars, yards, and premises in connection with interstate shipment of livestock. The disinfectants, supplied largely by commercial establishments, were, on the whole, found to be of satisfactory quality.

#### FIELD TESTS FOR DIPPING BATHS

During the calendar year 1925 the laboratory prepared and forwarded to

inspectors in the field for testing the strength of dipping baths 152 new test outfits for arsenical dips and supplies sufficient to make 316,600 field tests, 53 new test outfits for lime-sulphur dips and supplies sufficient to make 9,300 tests, and 18 new outfits for testing nicotine dips and supplies sufficient to make 3,070 tests.

During the year there was developed a new field test to enable field inspectors to determine the amount of phenol in water solutions and in serums and viruses. For this purpose 20 outfits and sufficient supplies to make 2,200 tests were furnished to field inspectors. It is believed that this new field test will be of much service in the enforcement of the virus-serum toxin act.

#### THE MODE OF ACTION OF DISINFECTANTS

A study of the mode of action of disinfectants showed that the secondary and tertiary alcohols and paraphenols possess bactericidal efficiencies which are in definite and regular relationship as between the different members of any given series. Additional work along this line has been begun with the cyclohexanols and with various disubstituted phenols. Some work has also been done with the resorcinols and isoresorcinols and their ketones. A great deal of difficult and valuable work has been done in the preparation in pure form of various rare members of the different series of compounds mentioned above. A number of these products have proved to be of exceptionally high bactericidal power.

#### THE MECHANISM OF DEFLOCCULATION BY SOAP SOLUTIONS

The study of the power of various soap solutions to deflocculate carbon black has been continued. Attention was paid to the concentration, temperature, time, the nature of fatty acid, and nature and proportion of alkali. The results indicate that deflocculation is effected only by molecularly dissolved or ionized soap, the colloidal fraction being inert at equilibrium.

#### HOG-CHOLERA INVESTIGATIONS

During the year the study of occasional failures of pigs to acquire the desired immunity after immunization against cholera has been continued by immunizing several hundred sucking pigs at six Government-owned farms. The ability to carry out the work simultaneously on different farms in different sections of the country is a

great aid to the work, but even so the investigation to be finally conclusive will have to be carried on over a period of years before data can be obtained and principles formulated which will apply throughout the country.

Especial study of the effect on hog-cholera immunity of other concurrent infections was started during the year and is now being carried forward.

Inasmuch as occasional success appeared to follow the use of formalinized virus as a vaccine, the study of this question was continued during the year and is still under way, attempts being made to ascertain just what factors were responsible for success in some cases and failure in others.

#### THE EFFECT OF *B. SUPESTIFER* IN VIRUS ON RESULT OF SIMULTANEOUS INOCULATION

Hog-cholera virus when first obtained by bleeding infected pigs at times contains considerable numbers of *Bacillus suipestifer*. Previous experiments have shown that this organism considerably enhances the disease-producing power of blood from sick pigs. During the year there were vaccinated in a comparative way 232 pigs—127 receiving virus containing *B. suipestifer* and 105 with virus from which that bacillus was absent. All the pigs which survived the vaccination treatment were tested later for immunity. There appeared to be no difference in the degree and permanence of the immunity produced by virus containing *B. suipestifer*, on the one hand, and virus from which the bacillus was absent, on the other. The experiments showed, however, that vaccination virus containing large numbers of *B. suipestifer* at the time of injection was liable to produce a so-called vaccination break. In view of these results a study was made of the length of time *B. suipestifer*, when present naturally in the blood of hogs sick with cholera, might remain alive after the addition of 0.5 per cent phenol to the defibrinated blood of such pigs. It was found in the cases studied that *B. suipestifer* in the virus blood was killed within eight days after addition of the phenol, or, more correctly speaking, its capacity to grow or multiply in artificial media was completely inhibited after eight days' exposure to 0.5 per cent phenol.

#### BACTERIOPHAGE EXPERIMENTS

Following the technique of d'Herelle, efforts have been made to



determine whether or not there is associated with hog cholera and present in either the intestinal contents or in the blood of cases of hog cholera a bacteriophage. The results of this work were entirely negative.

#### HOG "FLU" INVESTIGATIONS

The disease, hog "flu," which for several years recently was prevalent in Iowa during the fall months, was comparatively rare last year. The idea has been rather prevalent that hog flu is disseminated by the return of hogs to farms after they had developed the flu at fairs. A careful investigation was made of fairs held in different sections of Iowa during the fall of 1925. As a result of this investigation and from information gathered from practicing veterinarians and others, it appears that show hogs which contract flu at fairs may communicate the disease to hogs on farms to which they return, but it does not appear probable that the widespread epizootics of flu which have been observed in the past originated in this manner. It still appears that poor housing of hogs and the subsequent exposure to cold are the most important factors on farms.

#### INSECTICIDE AND FUNGICIDE WORK

The division has continued the chemical examination of samples of insecticides and fungicides collected by the Insecticide and Fungicide Board, the samples examined being those intended for use in the treatment of cattle, sheep, swine, and goats. The examination of 123 official samples has been completed, and a considerable volume of correspondence has been carried on with manufacturers and with the Insecticide and Fungicide Board.

#### REPORT OF ZOOLOGICAL DIVISION

Near the beginning of the fiscal year the Zoological Division suffered a severe loss in the death of its chief of division, Brayton H. Ransom, on September 17, 1925. Doctor Ransom had been the head of the division since June 1, 1903, and had ably carried forward the work directed up to that time by his predecessor, Ch. Wardell Stiles. In a quarter of a century of productive scientific work he had shown an unusual ability to carry out the most careful scientific investigations and to establish practical procedures of great economic value on the basis of his scientific findings. Much

of the routine practice in tick eradication, field inspection, meat inspection, and livestock sanitation is based on his individual work. In losing him the bureau lost an outstanding authority on such important subjects as trichinosis, ascariasis, stomach worms, cysticercosis, and other major topics in parasitology. He was a considerate and friendly executive, and as a result had built up a high morale in his division. This morale has enabled the division to carry on efficiently. It has continued its investigations of animal parasites and parasitic diseases under the direction of Maurice C. Hall, who was appointed chief of the division October 1, 1925.

#### ROUNDWORMS AND OTHER INTERNAL PARASITES OF SHEEP

The experiments on sheep parasites, begun in 1914 on the experiment farm at Vienna, Va., were brought to a close early in 1926 and the entire project transferred to McNeill, Miss., to meet, in part, the need for an investigation of parasites of livestock in the South and to develop control measures for sheep parasites adapted to southern conditions. During a period of almost 12 years this work has been concerned in establishing an effective and practical procedure in raising sheep without losses from parasites. When it was first begun it was thought that a pasture-rotation system of a feasible sort could be developed for the control of roundworms, especially stomach worms, in sheep. This belief was not substantiated by tests. Stomach worms appear to be very hardy and prolific worms, the eggs on pastures hatch promptly, and the larvæ become infective in a short time; and since sheep are grazing animals which soil their feed with their feces, only prompt and frequent transfers away from infected pastures will avoid severe infestations. Apparently these transfers would have to be made about once every three weeks, and the infected areas vacated would need to be left ungrazed for at least a year to make them reasonably safe for sheep or else would have to be turned over and sown. Such a program calls for a prohibitive cost in the fencing needed. It might be approximated by the use of hurdles, such as are used in England and Scotland for holding sheep, but the use of hurdles does not appeal to the American farmer.

Following the determination by critical testing in this division of the high value of the copper-sulphate solution proposed by Hutcheon many years



ago for the removal of stomach worms, the use of this solution was tested on the flock at Vienna with excellent results. It was found that treatments of the entire flock at three-week intervals from spring through fall would give practically complete insurance against any evident loss from stomach worms. This method has the advantage over pasture rotation that every three weeks it removes almost all the worms present in the sheep, whereas pasture rotation at the same intervals would leave these worms. The treatment is very cheap, easily administered, and safe if given with reasonable care.

After the value of the copper-sulphate treatment was established, a solution of copper sulphate and tobacco infusion was tested and found to be apparently somewhat more effective, especially in the removal of tapeworms. Dosing with a powder containing copper sulphate and sodium arsenate also prevented losses from stomach worms, but did not keep down the numbers of worms present so well as did the treatments previously mentioned. A mixture of tobacco dust and salt, to which the sheep were allowed access at all times, did not prevent serious losses from stomach worms, although it seemed to have some value in the control of tapeworms. A solution of nicotine sulphate did not appear to be so satisfactory as the copper-sulphate solution, but a solution of copper sulphate and nicotine sulphate was apparently effective.

At the beginning of the experiments at this station the sheep were heavily infested with hookworms. These worms disappeared in the course of the first few years, indicating that their eradication is feasible and apparently not especially difficult, a finding of considerable interest and importance. The precise causes for this result have not yet been ascertained. Another parasite of sheep, a roundworm occurring in the large intestine and known as *Chabertia ovina*, also disappeared from these sheep during the first few years. The other worms persisted, but in greatly diminished numbers. The administration of carbon tetrachloride 14 times during the course of a year to a small flock apparently cleaned out the nodular worms and whipworms and greatly diminished the numbers of stomach worms, thin-necked strongyles, and small trichostrongyles. It is possible that the continued use of this drug would have resulted in the complete eradication of some or all of these

worms in time, provided the sheep were kept on the same pastures and no other animals allowed to bring in fresh infection.

After having demonstrated at Vienna that a flock of sheep under the control of a veterinarian could be handled in a practical manner with a resultant control of stomach worms and related worms an experiment was begun in 1922 at Queen City, Mo., to ascertain whether the same procedure could be carried out on farms under the supervision of a veterinarian. Twelve farmers put their flocks in this experiment and 11 of these continued in it throughout. The flocks totaled 1,257 sheep and lambs at the beginning of the experiment and 1,461 at the conclusion; including the annual lamb crop the total number dosed reached over 2,000 each year. The sheep were dosed at 25 to 28 day intervals with the 1 per cent copper-sulphate solution. At the beginning of the experiment all flocks showed evidence of stomach worms and the owners reported heavy injuries and losses from this cause. The degree of infestation present in each flock was ascertained roughly by sampling, 12 to 14 fecal samples being collected from each flock at each dosing period and the feces being examined microscopically and by culture to ascertain in a general way the extent of stomach-worm infestation and, incidentally, of infestations with other worms.

The results of the Queen City experiment confirmed those obtained at Vienna. The flocks under treatment were kept on permanent pasture, practically pastured to its carrying capacity, but the treatment prevented loss or serious injury. It may be noted that the losses by death from stomach worms in some places observed apparently amount to 10 to 15 per cent, mostly among lambs, and in many flocks the loss is much greater. Under treatment the flocks go into the winter in good condition, the ewes give more milk, the lambs make larger and faster gains, and the entire flock produces more wool and mutton than would be the case without treatment. On the Vienna farm a flock of ordinary grade sheep was brought up to a show flock by parasite control, intelligent feeding and handling, and the use of purebred rams. These three factors—parasite control, feeding, and breeding—are basic in the development of sheep and the avoidance of losses by death, unthriftiness, and related conditions.

Having demonstrated in Virginia and in Missouri the efficiency of the treatments and the practicability of raising sheep without losses as a result of the routine use of the copper-sulphate or an equivalent treatment, the project has now been transferred to the South. Little attention has been given to parasite control under southern conditions. If the present methods prove unsatisfactory when given adequate test, it is believed that satisfactory measures can be developed.

#### ROUNDWORMS OF SWINE

The swine-sanitation project for the control of roundworms which was begun in 1919 in McLean County, Ill., was discontinued at that point in 1926 and transferred to Moultrie, Ga. The reason for the transfer was, as in the case of the Vienna sheep project, to meet, in part, the need for an investigation of parasites of southern livestock and to adapt to southern conditions the measures developed in the Corn Belt. The project as developed in Illinois has been surprisingly successful in preventing losses of little pigs from worms and associated hog-lot diseases, and has spread widely through the Middle West. It has enabled farmers to raise as many pigs from two sows as they could raise under dirty hog-lot conditions from three, and farmers using the system report that they market 95 per cent of the pigs farrowed. This latter claim has been challenged and possibly does not represent an average, but our figures indicate that individual farmers at least do attain this. The pigs raised make rapid gains, are ready for market four to eight weeks before pigs raised under the more usual conditions, and are larger and more uniform, being marketed without runts or culls for the most part. These gains represent big savings in labor, feed, services, and other items.

Since this system was developed under the climatic and farming conditions of the Middle West it will probably require more or less modification to adapt it to southern conditions. The transfer of the project to Moultrie, Ga., will afford an opportunity to make these adaptations in an important swine-raising center. In addition, it will afford an opportunity to determine the value of the system as modified to control other swine parasites not involved in the McLean County area, such as kidney worms, these worms being very prevalent in the South and causing much loss as a

result of condemnation of infested parts. Control measures for these worms are not yet developed and are greatly needed. In this connection it has been found that a species of nodular worm recently described as *Eso-phagostomum longicaudum* from swine in New Guinea also occurs in the United States and in the Philippines.

#### CONTROL OF EXTERNAL PARASITES

Lime-sulphur dip and nicotine solution were found to be the most satisfactory remedies for sarcoptic mange in horses, 4 to 6 dippings at 5 to 7 day intervals usually effecting a cure, except in old, chronic cases. A manuscript for Farmers' Bulletin 1493 on lice, mange, and ticks of horses was issued.

Field tests with dry lime-sulphur were continued in various parts of the country and the product found to be a dependable remedy for sheep and cattle scabies, provided it is properly dissolved in hot water.

Continued experiments with the wading-tank method of treating cattle to prevent ox-warble infestation indicated that mixtures of crude petroleum and pine tar were no more effective than crude petroleum alone. They had about equal value, but neither entirely prevented infestation when applied to the lower parts of the legs of cattle.

In association with the Insecticide and Fungicide Board, the division carried out tests of a miscellaneous lot of commercial insecticides and continued investigations looking toward the development of satisfactory treatments for follicular and sarcoptic mange in dogs.

#### TESTS OF ANTHELMINTICS

An extensive series of tests was made to ascertain some satisfactory treatment for the removal of tapeworms from poultry, there being considerable demand for this information owing to the lack of knowledge as to a dependable treatment. These tests developed the fact that kamala, a drug long used in India for the removal of tapeworms from man, and also used to remove tapeworms from dogs and other animals, was very effective in removing tapeworms from poultry. Other drugs used as tæniacides for other animals proved failures on tests with chickens, and this has been the usual report by other workers. In doses of 1 gram to each bird, kamala removed all the tapeworms from the large majority of birds treated. The



dose for turkeys, judged from a small number of tests, is 2 grams. No bad effects were observed in the birds treated even after the administration of 10 grams of kamala to chickens. However, subsequent reports on the use of the drug indicate that, like other anthelmintics, it has certain contraindications for its use, and these will undoubtedly come to light as the drug receives additional study.

Tetrachlorethylene, a drug developed in this division last year for the treatment of hookworm infestations, has been used rather extensively in the treatment of dogs and is now marketed commercially for that purpose. It appears to be especially safe for administration to pups, excelling carbon tetrachloride in this respect. Preliminary reports of its use for removing worms from foxes are favorable. The drug has been used in a few cases of hookworm disease in man, but the reports are not extensive enough yet to establish its value in comparison with carbon tetrachloride. A flock of sheep was treated every three weeks for a year, but the results did not indicate that the drug was any improvement over carbon tetrachloride for use on sheep.

In view of the interest in iodine as an anthelmintic, some preliminary investigations of iodine and its compounds were carried out. No strikingly valuable results were obtained, but further investigations are being made. Other investigations have involved tests of tobacco and nicotine for worms in poultry, without developing any new findings. Tests of nicotine and other drugs on sheep were carried out.

Preliminary tests of mercurochrome as an anthelmintic for removing worms from dogs have been carried out and indicate that in repeated doses this drug is very effective in removing whipworms. The most striking feature of these tests, however, is the fact that the drug, which is also a stain, can be traced through the digestive tract of the host and into the bodies of the worms affected by it. This fact may enable us to ascertain basic facts, now unknown, as to the course of anthelmintics in a host and the method by which they attack and injure worms.

#### FLUKES AS A CAUSE OF SALMON POISONING OF DOGS

During the year investigators at the Oregon Agricultural College and Experiment Station, Corvallis, reported that they had found the cause of

so-called salmon poisoning of dogs on the west coast of the United States to be a small fluke occurring in large numbers as adults in the small intestine of the affected dogs and occasionally of foxes, and as encysted metacercariæ in the muscles, kidneys, liver, and gills of salmon (*Salmo* spp.) and trout (*Oncorhynchus* spp.). Feeding experiments showed that the dogs to which were fed the infested fish, known in the case of salmon as "sore-back" salmon, developed typical cases of salmon poisoning and were found on post-mortem examination to have enormous numbers of very small flukes, about 0.5 millimeter long, in the intestine. Two consignments of infested fish tissues were shipped by Doctor Simms, one of the investigators, in vacuum bottles across the continent to the Zoological Division in Washington, and in spite of pronounced putrefaction after inclosure in a sealed bottle for five days or more the metacercariæ were viable, produced heavy infestations on being fed to dogs, and in one case produced the typical symptoms of salmon poisoning, with the death of the dog. The fluke was studied in this division and found to belong in the family Heterophyidæ; it was described as a new genus and species, *Nanophyes salmincola*.

In the course of investigations on parasites of wild carnivores, a project made possible by the cooperation of the Bureau of Biological Survey and under way for the last three years, additional information, potentially of considerable importance, was obtained in regard to salmon poisoning. The viscera of a coyote sent in by the survey from the State of Washington was examined in the routine manner for parasites and found to have an enormous number of *N. salmincola*. The Oregon workers reported that coyotes were scarce in the "salmon-poisoning" areas of Washington, Oregon, and California, and that the natives claim that coyotes are practically all killed here by eating dead "sore-back" salmon found along the banks of the small mountain streams during the spawning season. Our findings establish the coyote as a host of the pathogenic salmon-poisoning fluke, and suggest that individual coyotes, at least, are relatively resistant to the bad effects of the flukes, since this coyote had many more flukes than one of the dogs in our experimental feeding work, and yet this dog was killed, whereas the coyote was still traveling and apparently uninjured. Subsequently the fluke was



found in the viscera of a bobcat and raccoon sent in from the State of Washington.

#### OTHER PARASITIC FLATWORMS

Other studies on flukes include a study of some new species of the Heterophyidae, the description of the flukes of insectivora, including a peculiar, new species from a shrew, and a redetermination of the flukes in the parasite collection of the bureau for those cases in which the flukes were collected from domesticated animals or closely related hosts.

The experiments on the life history of anoplocephaline tapeworms are still being continued. The economically important tapeworm, *Tenia krabbei*, has been restudied in connection with related tapeworms from Alaskan dogs and the relation of all these dog tapeworms to cysticerci occurring in reindeer in Alaska and in wild deer in the northwestern United States. A very peculiar larval tapeworm was found in the gizzard of a duck.

#### NEMATODE PARASITES

The monograph on bird nematodes, exclusive of filarids and trichurids, referred to in last year's report, has been sent to press. In connection with this work certain bird nematodes have been found to be highly pathogenic and part of these findings have been published. Such nematodes were found to be the probable cause of deaths of turkeys, geese, pigeons, and teal. Intestinal nodules were reported for the first time as due to *Heterakis beramporia*; these were in chickens in the Philippines. Nematodes collected by investigators outside of the department engaged in a study of quail and ruffed-grouse diseases were identified in the division for these workers. A number of nematodes were reported from this continent for the first time or from new hosts. A highly pathogenic nematode of turkeys is being studied to ascertain its life history and the clinical conditions associated with its pathological features. Studies on ascarids have been continued, and it has been found that *Ascaris vitulorum* of cattle, reported last year for the first time in this country, occurs not only in Louisiana, as reported, but also in Texas and Mississippi. Attempts to transmit human ascarids to swine and to transmit swine ascarids to monkeys have yielded negative results, although a check experiment in the form of an

attempt to transmit swine ascarids to swine under similar conditions was successful. A restudy of the egg-producing capacity of the female ascarid failed to confirm the high numbers given by former workers and indicated that the female worms contain from 26,000,000 to 27,000,000 eggs each, rather than 64,000,000 to 70,000,000 as previously reported. A comprehensive paper on ascariasis was published, showing its extent and seriousness, and the indicated control measures for it.

Experimental studies of the life history of swine lungworms indicate that the larvae do not undergo any evident development in cultures, including cultures with swine manure. Studies in cooperation with the Pathological Division have indicated that certain lung lesions very similar to tuberculosis lesions in gross appearance, but due to lungworms, may be distinguished from tuberculous lesions very quickly by a press preparation which shows under a lens a very distinctive appearance, due to the filling of the alveoli with leucocytes.

A study of the swine whipworm, *Trichuris suis*, shows no morphological differences between this form and the human whipworm, *T. trichiura*, and indicates that the two forms are identical, a view held by older workers and subsequently abandoned on what appears to have been insufficient evidence. The possibility that man may become infected with whipworms from swine is of considerable interest, and experiments on the transmission of human whipworms to swine are now in progress.

Experiments in the feeding of meat containing trichinae killed by suitable measures showed no evident, bad effects in experiment animals and indicate that such meat is entirely harmless.

A number of nematode species were studied or restudied from a taxonomic standpoint and papers were published on parasitic nematodes from China, on horse strongyles, on a new nematode from the rat and its life history, and a new hookworm from the raccoon. A new project, an investigation of cattle parasites, especially nematode parasites, was begun at Jeanette, La.

#### MISCELLANEOUS INVESTIGATIONS

An investigation of the longevity and fate of eggs and larvae of parasitic worms in piles of horse and cattle manure was begun this year. Although similar problems have received

more or less attention in connection with the longevity and fate of parasite eggs and larvæ in human feces, the animal life of barnyard and stable manure has had very little attention except in connection with fly breeding. Information as to the length of time infective parasite material survives under various conditions in these manure piles is needed to determine the conditions under which the manure may safely be spread on fields without conveying infective material to livestock.

To answer in part an inquiry as to whether it is safe to eat ducks infested with sarcosporidians, *Sarcocystis rileyi*, the heavily infested flesh of ducks, fresh and cooked, and also fresh and cooked water extracts of such flesh were fed by mouth, and in the cases of the extracts were also given subcutaneously, to rats, guinea pigs, and rabbits. No visible, toxic results were noted, indicating that such meat is probably not dangerous for human consumption, although esthetically objectionable. Certain sarcosporidians have been reported as possessing decidedly toxic properties; this common duck sarcosporidian does not appear to possess them.

The investigation of parasites of wild carnivores, carried out with the cooperation of the Biological Survey, has been continued, and there is a growing collection from coyotes, wolves, foxes, lynxes, mountain lions, cougars, bears, skunks, and raccoons, of which about 80 such animals have been examined. One of the preliminary findings of interest in this project, already noted, is the finding in the coyote, raccoon, and bobcat, in Washington, of the fluke responsible for salmon poisoning in dogs.

In collaboration with the Hygienic Laboratory of the United States Public Health Service a key catalogue of the worms reported from man was published, following a similar bulletin on the protozoa from man. Other bulletins are in course of preparation. Miscellaneous papers published include papers on laboratory methods, on parasites of the horse in the Philippine Islands, on parasites of domesticated animals in general in the Philippines, on a mite from the turkey, on parasites of the goat, and on parasites of the deer.

As in previous years, a number of American and foreign parasitologists spent from a few days to several months in the laboratory, taking advantages of its catalogues and indexes, its comprehensive collection of parasite

figures, its parasite collection, and its library facilities.

## EXPERIMENT STATION

The general character of the work of the experiment station at Bethesda, Md., under E. C. Schroeder, superintendent, was similar to that of previous years. It comprised independent investigations of the infectious diseases of the lower animals, studies of various foods derived from animals with regard to their possible contamination with disease germs, tests of the value of alleged remedies for and immunizing agents against infectious diseases, investigations in cooperation with other scientific divisions, and the furnishing of facilities for other divisions to conduct investigations under natural or normal farm conditions.

### BOVINE INFECTIOUS ABORTION

The study of bovine infectious abortion was continued throughout the year. Although nothing entirely new regarding it was discovered, previously reported discoveries received further confirmation. At present it seems particularly desirable to test the immunizing value of cultures of abortion bacilli which have partly or wholly lost their pathogenic virulence during growth under artificial conditions, as well as to determine whether strains of the bacilli derived from swine may be used to immunize cattle and strains from cattle to immunize swine.

Interesting data on the effect of infectious abortion on the milk and butterfat production of dairy cows have been collected. Though by no means sufficiently abundant to support a final conclusion, they indicate that even apparently healthy cows that react positively with seriological abortion tests are decidedly less productive than cows certainly free from the infection.

To judge from the station's work and reports published from time to time, the sanitary control methods for infectious abortion based on the known etiology of the disease, such as the use of bull pens, maternity stables or pens, and the separation of reacting and nonreacting cattle, give excellent results.

### TUBERCULOSIS

A method of immunization against tuberculosis, devised and advocated by Albert Calmette, associate director of the Pasteur Institute at



Paris, France, is still under investigation. The alleged immunizing agent is an originally virulent bovine tubercle bacillus which has lost its virulence or pathogenic potency under long-continued, artificial cultivation, and which is now widely known as the "B. C. G." vaccine. There is nothing radically new about attempts to obtain immunity against tuberculosis in that manner. In one respect, however, the Calmette vaccination differs from other methods, and that is the requirement that the vaccine be applied before virulent tubercle bacilli have entered the body.

The station's investigations, so far as they have gone, show that the B. C. G. vaccination causes a distinctly increased resistance against tuberculosis, but not a perfect immunity, in young cattle that are vaccinated and subsequently injected, intravenously, with suspensions of virulent tubercle bacilli. As the intravenous injection of virulent tubercle bacilli may be regarded as a very severe exposure, which practically never occurs under natural conditions, this may be interpreted as encouraging rather than the contrary. At the same time, as the complete eradication of a bacterial disease through the agency of a vaccine has never yet been accomplished, we should not assume too hurriedly that B. C. G. vaccination will prove a suitable or profitable substitute for the bovine tuberculosis eradication methods which are now in use and giving excellent results in the United States.

Our aim, with the low percentage of tuberculosis among our cattle, should be eventual, complete eradication. The vaccine does not, and is not claimed to, improve the condition of actually tuberculous cattle. In countries in which the proportion of cattle affected with tuberculosis is from ten to twenty times greater, the B. C. G. vaccination of calves, if the claims made for it are true, may prove an expedient of enormous value.

Considerable work was done on the differences in the sensitiveness for tuberculin caused by different types of the tubercle bacillus in the bodies of animals, and this showed that each type as a rule has a somewhat stronger tendency to sensitize for the kind of tuberculin it produces than for other kinds. There seems to be no practical difference between the sensitiveness produced by either human or bovine

types of the tubercle bacillus for either human or bovine tuberculin, but the sensitiveness produced by the avian tubercle bacillus, strong for avian, is very weak for human or bovine tuberculin.

Special studies were made on the subject of so-called no-lesion, tuberculin-reacting cattle, but, beyond determining that approximately, on a general average, about 1 among 400 cattle react with tuberculin without discoverable cause, not much progress has been made. There is little doubt, however, that the absorption of human tubercle bacilli by cattle in an environment where such bacilli are abundant, accounts for some proportion of no-lesion reactions.

#### EQUINE VESICULAR STOMATITIS

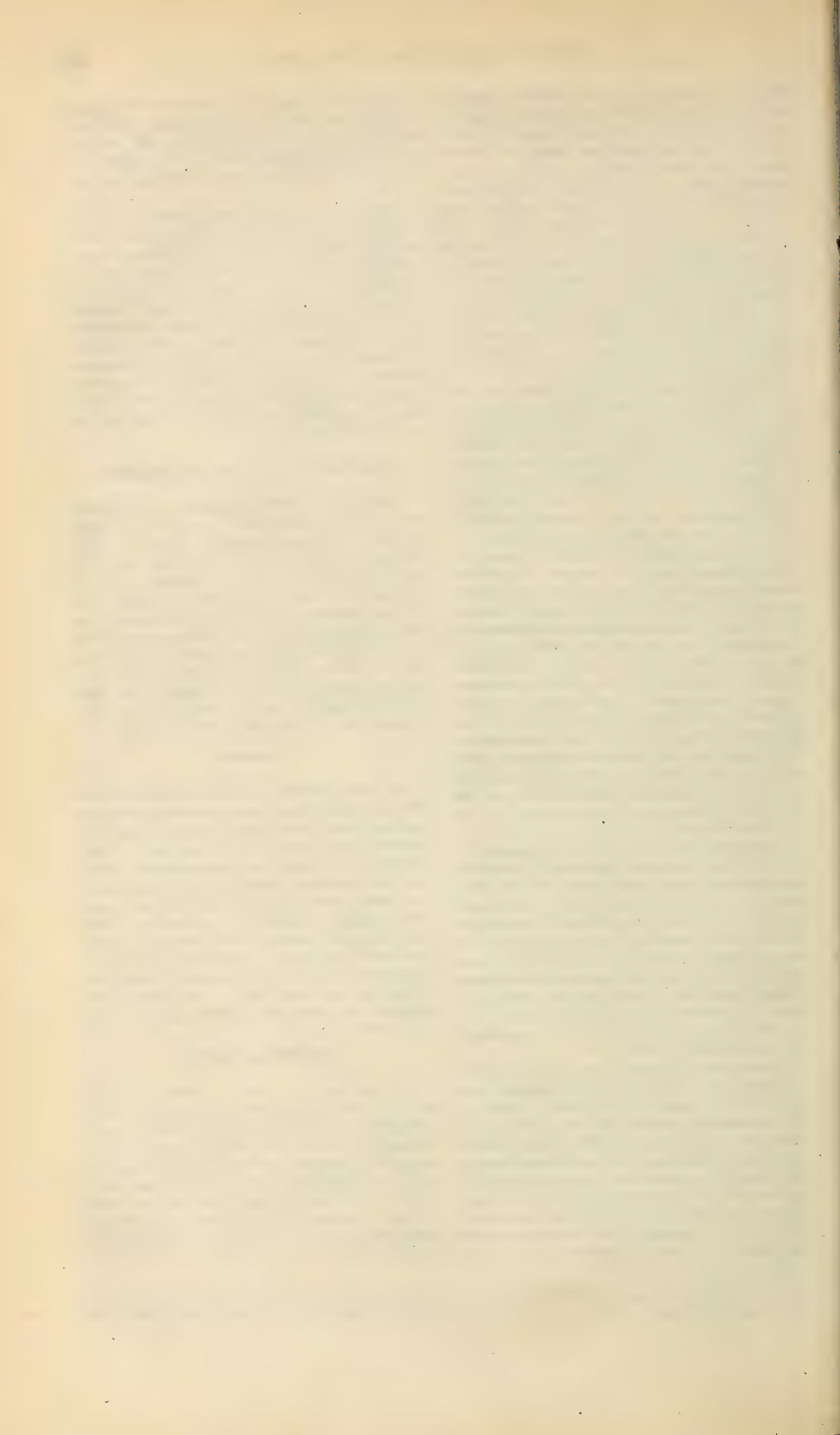
Owing to the similarity of lesions of equine vesicular stomatitis and those of foot-and-mouth disease, considerable attention was given to the study of the former disease. As a result it was discovered that its virus causes lesions in guinea pigs indistinguishable from those caused by the virus of foot-and-mouth disease. The importance of this discovery lies in the fact that the guinea pig has been thought to be serviceable for diagnosing foot-and-mouth disease.

#### RABIES

It is desirable to call attention to the extraordinary prevalence of rabies during the year in the territory in which the station is located. The number of rabid animals dealt with at the station during the year was, in fact, greater than during any previous entire decade. So far as could be learned there are several other regions similarly troubled. It is regrettable that a general, effective muzzling of all dogs that are permitted to run at large can not be enforced.

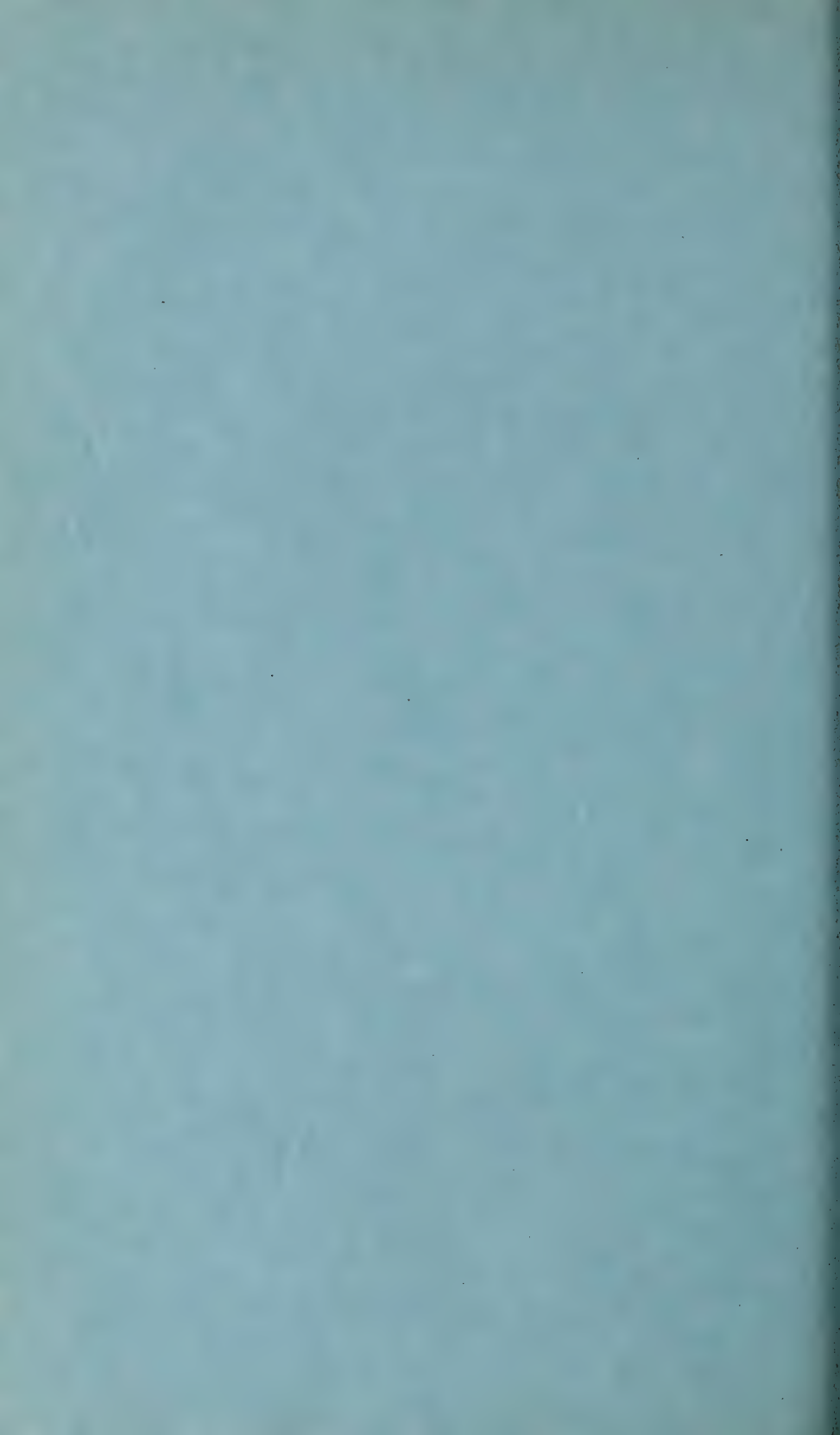
#### MISCELLANEOUS

A number of minor investigations were made, dairy products were tested relative to their contamination with tubercle bacilli, a large number of small experiment animals were raised, and all portions of the station not needed for other purposes were kept under intense cultivation to obtain fresh-vegetable feed for experiment animals.











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## REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY

UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF BIOLOGICAL SURVEY.

*Washington, D. C., August 20, 1926.*

SIR: I have the honor to submit herewith a report of the operations of the Bureau of Biological Survey for the fiscal year ended June 30, 1926.

Respectfully,

E. W. NELSON,  
*Chief of Bureau.*

Hon. W. M. JARDINE,  
*Secretary of Agriculture.*

### ORGANIZATION AND FUNCTIONS

Organized as a separate branch of the Department of Agriculture 40 years ago (July 1, 1886), the Bureau of Biological Survey, then designated the Division of Economic Ornithology and Mammalogy, has developed steadily in usefulness as new duties have been added and now may be said to function along all lines having to do with the conservation, utilization, and control of wild life. Wild life, as here used, embraces the birds, mammals, reptiles, and amphibians—all the vertebrates except fishes. The study of their habits, distribution, and economic relationships involves a wide range of investigation. The conservation of the valuable and harmless and the control of the injurious species present many difficult problems, which involve the interests of the people of the entire country to a much greater extent than is commonly understood. The functions of the bureau are performed through seven divisions, as follows:

Economic Investigations, A. K. Fisher, in charge. Studies are made of the economic relations of wild mammals and of effective methods of controlling their depredations in areas devoted to agriculture, stockraising, horticulture, and forestry, and leadership is furnished in cooperative cam-

paigns for the extermination of predatory animals, destructive rodents, and other injurious species.

Fur Resources, Frank G. Ashbrook, in charge. Experiments are conducted in the production of fur-bearing animals in captivity and under wild and semiwild conditions, including rabbits for meat and fur, and measures are investigated for the prevention and cure of parasitic and other diseases of animals on fur farms and for the utilization of fur as a natural resource.

Food Habits Research, W. L. McAtee, in charge. This division investigates the economic status of birds, reptiles, and amphibians through field and laboratory studies of their food habits, with a view to making recommendations for the control of the harmful and the conservation of the useful species; and studies the food resources of water areas suitable for migratory wild fowl and methods of increasing game and other useful birds.

Biological Investigations, H. H. T. Jackson, in charge. Field and laboratory investigations are made of the classification, distribution, migration, and other habits of native wild birds, mammals, and plants, biological surveys are conducted over major areas, and maps are made of natural life zones to provide the fundamental scientific information necessary for

use in the economic, regulatory, and other activities of the bureau.

Alaskan Wild Life, the chief of bureau and W. F. Bancroft, in charge. Investigations are conducted for the improvement of reindeer in Alaska, and for developing sheep grazing and fur farming within the Aleutian Islands Reservation; field studies are made of the habits and distribution of the valuable wild life; and through representation on the Alaska Game Commission assistance is given in the protection and upbuilding of the fur, game, and other wild-life resources of the Territory.

Game and Bird Reservations, E. A. Goldman, in charge. The establishment of wild-life refuges is promoted, and 72 Federal reservations for big game and birds are maintained, including the Elk Refuge in Wyoming, where hay is produced for winter feeding; and the problem of utilizing the increase of game on reservations is studied with a view to restocking other areas or selling or otherwise disposing of the surplus.

Protection of Migratory Birds, Talbott Denmead, acting in charge. Federal laws are administered protecting migratory game and other birds, governing interstate commerce in game, and regulating importations of foreign wild birds and mammals. Early in the fiscal year George A. Lawyer resigned as chief United States game warden in charge of this division and H. P. Sheldon was appointed to succeed him, reporting for duty on July 14, 1926.

### ECONOMIC INVESTIGATIONS OF WILD ANIMALS

Wild animals in the United States have taken full advantage of the increase of crop and livestock production and from the first settlements have exacted tribute from agriculture amounting during a long period to many millions of dollars annually. Extended investigations have been necessary to determine the character and extent of their destructiveness, the animals responsible, the relation that these animals may sustain to agricultural interests, and methods of combating them. Prevalence among wild animals of diseases communicable to man or domestic animals likewise has required the employment of control measures. Wherever repressive measures have been necessary, effective and economical methods and plans of organization have been devised to

meet various situations in a practical way. Constant study is made to develop more effective and economical methods and the present year has shown excellent results in this direction.

To accomplish adequate control at a minimum cost the Biological Survey has enlisted the cooperation of Federal, State, and local agencies on an extended scale and has provided trained and experienced leadership in coordinating field work. Research and field operations vigorously prosecuted during the year have shown a high degree of effectiveness and have made a material reduction in losses from animal pests.

Approximately \$462,240 in Federal funds were available for investigational work and for field operations on the public domain and for cooperative work elsewhere. Of this sum \$21,340 was used in investigational work, \$274,220 in the destruction of predatory animals, and \$166,680 in the control of rodents and other small animal pests. Organized field work was conducted in 17 States, which provided by appropriation and otherwise cooperative funds of approximately \$989,620, an increase of about \$150,000 over similar funds available during the previous year. Of these cooperative funds approximately \$375,060 was expended for the destruction of predatory animals and \$614,560 in rodent-control work.

At the time the Biological Survey began its control of predatory animals the annual losses from these destructive pests to the livestock growers of the West were estimated to lie between \$20,000,000 and \$30,000,000. As a result of the work of the bureau and its cooperators gray wolves have been nearly eliminated from the ranges, and hundreds of thousands of coyotes and other predatory species have been destroyed. This has resulted in a permanent lessening by more than half of the former losses from this source, in addition to the saving made by the animals killed each year. Counting the permanent results, the annual savings to the livestock growers from the predatory-animal campaign may be conservatively estimated as between \$12,000,000 and \$15,000,000.

At the time the Survey began its work on a large scale for the control of the wild rodent pests the annual losses were estimated to approximate \$300,000,000. The work of the bureau and its cooperators has resulted in



enormously decreasing the number of rodents over a vast territory, approximating 138,000,000 acres. It is difficult to estimate the amount of the gross savings in this instance, but there is little question that the increased annual crop and forage production runs into tens of millions of dollars in value.

#### PREDATORY ANIMALS

Operations for the control of wild-animal destroyers of livestock and game have been conducted in 14 States—Arizona, California, Colorado, Idaho, Illinois, Montana, Nevada, New Mexico, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. During the year the skins and scalps of 202 wolves, 35,619 coyotes, 3,149 bobcats, 55 Canada lynxes, 167 mountain lions, and 176 stock-killing bears were turned in as evidence of kills by hunters working under the bureau's supervision, and in addition it is estimated that approximately 70,000 coyotes were killed, the skins and scalps of which were not recovered because of the impracticability of locating all the carcasses after poisoning operations. On the generally accepted basis of computing losses inflicted by predatory animals, this year's operations represent a saving of livestock and game valued at more than \$5,000,000.

The year's work has been conducted in cooperation with State departments of agriculture, State livestock commissions, game commissions, agricultural extension services, and stockmen's associations, and with individuals, and effort was made to utilize every possible assistance that might be rendered by other Federal, State, or local agencies. Special emphasis has been placed on helping stockmen to help themselves. To this end demonstrations have been given on the stock ranges of effective methods employed in trapping and poisoning, and aid has been rendered stockmen in obtaining at reduced cost the poison needed for this work. Persistent poisoning, trapping, and den hunting have struck predatory animals a heavy blow, and sweeping headway is being made in bringing them under control and greatly reducing the losses from this source.

#### WOLVES

The large gray, or lobo, wolves have been so reduced that their depredations are almost ended. Highly skilled men trap or kill with poison the few

scattered individuals promptly after their presence on the range is reported by interested stockmen. As against 31 wolves taken in New Mexico last year only 8 were taken this year, despite increased efforts to get the last one in the State. Arizona, with 18 taken during the year, reports no wolves now known to be within its borders. It is necessary, however, to maintain a constant patrol along the New Mexico and Arizona boundary to prevent invasions of timber wolves and mountain lions from Mexico. For the first year in the history of the work not a single lobo wolf was taken in Colorado and less than half a dozen are known to range within the State. The catch in Montana was 28; in Oregon, 1; South Dakota, 6; Utah, 8; and in Wyoming, 12.

#### COYOTES

Extended poisoning campaigns, with strychnine specially prepared by the bureau for the purpose, have proved the most effective weapon for killing the bulk of the coyotes destroyed. The campaigns are organized in close consultation with stockmen and cover in a methodical way the important summer and winter ranges so far as funds permit and cooperation can be enlisted.

The hearty cooperation of stockmen has been an outstanding feature of the work. They have contributed funds, animals for poison stations, and personal services. As a result the losses due to the depredations of coyotes have been materially lessened. Following intensive poisoning and trapping operations around lambing grounds many stockmen report that their herds passed through the lambing season without a single loss or even hearing a coyote howl, and many sheep owners report that they have been able to reduce their labor costs more than half.

Typical of results from well-placed poison stations, one hunter in Colorado picked up 24 coyote carcasses about a single station at a natural crossing place, and no doubt more were killed than were actually found, because the surroundings were rough range lands with considerable brush.

Coyotes occur over such an enormous territory that they still continue to breed in places that it has not been possible to reach, and drift out from such points to restock areas that have been cleared, thus making it necessary to wage a continuous fight to afford protection on the livestock



ranges. They have increased in Illinois during the year and even invaded western New York.

In many localities reducing the numbers of coyotes has been followed by a marked increase in such game birds as grouse, quail, ptarmigan, sage hens, and wild turkeys, and in the number of young raised by deer and antelope.

#### MOUNTAIN LIONS

The 167 mountain lions destroyed during the year were distributed as follows: Arizona, 88; California, 6; Colorado, 6; Montana, 4; Nevada, 1; New Mexico, 44; Oregon, 7; Utah, 7; Washington, 4. Effort has been concentrated chiefly upon individual mountain lions that were reported on livestock ranges or, in cooperation with the State game departments, on animals that were destroying deer and other important animals on game ranges.

#### BOBCATS AND LYNXES

Considerable numbers of bobcats and lynxes occur in rough areas on stock ranges, and wherever they prove seriously destructive to livestock interests they can be brought under control with reasonable promptness by trapping and hunting with dogs. Many of these animals as well as coyotes are killed by private trappers for their fur.

#### BEARS

Generally bears are looked upon as relatively harmless animals and in many States are considered game. Individual bears sometimes become livestock killers, however, even when natural food is apparently abundant. Hunters of the Biological Survey are strictly instructed to kill only such bears as are known to be preying upon livestock, or in cooperation with State game departments, animals that are unduly destructive to other game. Limited in accordance with these instructions the kill of bears for the year totaled only 176 in the entire West.

#### RABIES CONTROL

The most serious of the sporadic cases of rabies among predatory animals in the Western States occurred this year in Washington and Colorado. Reduction in the number of coyotes has been a material factor in preventing outbreaks of this disease and helping suppress it when an outbreak

occurs. The field organization of the bureau is constantly alert, and as the result of experience, hunters are quickly concentrated to handle rabies outbreaks and promptly control and suppress them in cooperation with State and local health and sanitary officials. The saving to stock growers from rabies control alone is great.

#### FOOT-AND-MOUTH DISEASE AMONG DEER

It is a matter of gratification to report that the foot-and-mouth disease among deer in California, which was recounted in the previous report, has been completely suppressed. Good progress in the eradication of this dangerous disease had been made by the close of the previous fiscal year, but much work has been required during the current year to insure its complete eradication. Careful study was made to locate the various possible sources of infection, in order that these danger points might be effectively guarded and the disease prevented from spreading through the seasonal movements of the deer. In cooperation with the Bureau of Animal Industry and the California State Department of Agriculture, a strong force of hunters and veterinarians was maintained for this work, which also had the support of the State board of fish and game commissioners.

Hunters' camps also were located at each mountain pass in the Sierra Nevada to the south and east of the summer range where the disease had existed, and it is believed that not a deer passed through these defense lines during the summer, possibly to carry infection into new territory. At the beginning of the fall migration of deer into the lower country careful check showed no new infection or signs of old. The number of men employed was thereupon materially reduced, but careful observation was maintained to insure that no infected animals should be left at large. After the deer were established on the winter ranges they were watched carefully and an occasional one that showed some abnormality was killed for examination.

This went on until May, 1926, when officials of the Bureau of Animal Industry pronounced the disease entirely eradicated. The Biological Survey at once discontinued its activities along this line. As explained in the previous report this work was of an emergency character, and was undertaken by the bureau only upon urgent appeal by other Federal and State

agencies. Great credit is due the leaders and the experienced force of hunters that had been employed in predatory-animal and rabies-control work in California, who, through their knowledge, skill, and efficient service, made it possible absolutely to limit the spread of this dread livestock disease and to suppress it completely among deer, thus ending a serious menace to the livestock industry.

## INJURIOUS RODENTS

### POISON TESTS

The investigational program to develop new poisons for use in combating the various rodents that destroy farm crops, forage grasses, orchards, vineyards, and nurseries has been continued vigorously, the main objectives being increased effectiveness over present known methods and reduced cost of control operations.

Especially gratifying progress has been made in adapting various thallium derivatives for use in meeting specialized local conditions where other poisons and fumigants have not proved satisfactory. Developments of the year constitute important contributions to control methods for certain ground squirrels, prairie dogs, and house rats, and the discoveries will doubtless prove applicable to many other destructive rodents. The extreme deadliness of thallium products has led the bureau to proceed with caution in applying it under field conditions, in order to maintain safeguards against injury to valuable species as well as to persons engaged in the work.

Studies to determine manufacturing processes that will insure the maximum toxicity of red-squill products were conducted in collaboration with the office of drug and other plants, of the Bureau of Plant Industry, and with the pharmacological laboratory, of the Bureau of Chemistry. In field and laboratory tests with squill for the destruction of house rats, a stable and efficient poison has been developed to meet special requirements in the control of these widely distributed and highly destructive pests.

Important progress has also been made in adapting crude calcium cyanide for use against various species of rodents where fumigation methods are applicable.

### COOPERATION

Effort has been made at all times to articulate the work efficiently with all

other Federal, State, and local agencies with a view to avoiding duplication of effort and insuring the largest possible returns in service for funds expended. The bureau has continued its cooperation with the Office of Cooperative Extension Work, the extension-service organizations of agricultural colleges, including county agricultural agents, and with State departments of agriculture, county commissioners, and various agricultural, horticultural, and livestock organizations. In work on Federal lands it has had the cooperation of the Forest Service and the Bureau of Animal Industry, of this department, and the Office of Indian Affairs and the Reclamation Service, of the Department of the Interior.

### PRAIRIE DOGS AND GROUND SQUIRRELS

The work of reclaiming grazing lands and reducing losses of farm crops from the destructive activities of prairie dogs and ground squirrels has proved of such evident and direct value in the past that demand for it has greatly increased. Reports of stockmen and farmers show marked increase in carrying capacity for livestock on pastures and materially greater yields of forage and grain crops as a result of eliminating these rodents. First treatment with poisoned-grain baits was given to 10,571,296 acres of Federal, State, and private lands, and follow-up work to destroy most of the survivors on 4,486,674 acres. This brings the total acreage treated for control of these animals to 13,457,197 on Federal, and 124,880,786 on State and private lands. Stockmen and farmers have paid the cost of work on their own holdings and in addition have contributed many thousands of dollars worth of labor in distributing poison on adjacent Federal and State lands. Revolving funds have been continued by State officials and county commissioners to purchase and prepare poison supplies in wholesale quantities, and this has resulted in material saving in the cost of operation. The saving in crop and range grasses resulting from work during the year is estimated at more than \$6,800,000, without counting the permanent improvements from the work of previous years. A total of 1,218 tons of poison grain has been used in these cooperative poisoning campaigns. In addition 384,132 pounds of carbon disulphide and 184,041 pounds of crude calcium cyanide have been used as fumigants in follow-up opera-



tions to complete eradication of prairie dogs and ground squirrels not killed by poison.

#### POCKET GOPHERS

In response to increasing demands for assistance in controlling pocket gophers, demonstrations have been given and control operations carried on in Arizona, California, Colorado, Idaho, Kansas, Montana, Nevada, New Mexico, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. These pests were largely eliminated from 285,834 acres.

#### JACK RABBITS AND COTTONTAILS

Cooperative control of jack rabbits was continued in localities where these rodents had increased to destructive numbers or had migrated from open range lands to attack cultivated crops. In Arizona, 8,000 acres were treated with 2,000 pounds of poison, resulting in a kill estimated at 100,000 rabbits. In Idaho, early in the summer of 1926, when the rabbits were migrating in hordes from desert range lands into irrigated valleys, 50,620 pounds of poison were used on 369,150 acres, with excellent results. In seven counties in Texas, 423 farmers with 23,600 pounds of poisoned bait killed more than 50,000 rabbits, effecting a saving estimated at about \$44,000, at a cost of \$1,775.50. Important progress was made in investigations to improve washes for tree trunks to lessen the damage by cottontail rabbits to orchard trees.

Warnings were issued during the year in various forms against the danger from tularemia to persons engaged in handling and dressing jack rabbits, snowshoe rabbits, and cottontails. Cooperative work with the United States Public Health Service was begun to determine the possible relationship of this disease to the abundance of game and other forms of wild life.

#### WOODCHUCKS

The increasing abundance and destructiveness of woodchucks in many parts of the country have called for demonstrations of effective methods of control. In one county in Illinois it is estimated that 90 per cent of the woodchucks have been destroyed by use of crude calcium cyanide. In Indiana and Illinois use of 50,000 pounds of this material in accordance with methods demonstrated by the Biological Survey resulted in a saving to farmers estimated at \$250,000.

#### FIELD MICE

In California, Idaho, Oregon, Texas, Utah, Washington, and in many of the orchard sections of the Eastern States, an increase of field mice to destructive numbers has been reported locally. Widespread demonstration of control methods by field representatives of the bureau have led great numbers of orchardists to adopt field-mouse control as a regular feature of their orchard practice, and many now employ the special poison stations recommended by the bureau. In four counties of Idaho 6,900 pounds of poisoned bait were used. In the vicinity of one town in Indiana where demonstrations have been made within the past two years, at least 30,000 poison stations are now in use.

#### HOUSE RATS AND MICE

The bureau has continued investigations to determine methods adapted to meet the great variety of conditions under which house rats and mice must be combated in order to lessen the enormous losses to property and the serious danger to health involved in their presence. A number of special surveys have been conducted to note the conditions of rat infestation about warehouses, packing plants, and other places where damage to agricultural products occurred. Demonstrations were conducted and information given regarding control measures.

Results of surveys in agricultural and poultry-raising sections disclose that the numbers of rats are constantly augmented by their being carried in shipments of dairy and poultry feed from towns to farms. This emphasizes the nation-wide need for concerted effort between the rural and urban people as a basis for efficient control. The problem calls for widespread coordination of effort and the utmost persistence in the application of repressive measures. United action by representatives of farmers' organizations and chambers of commerce or other civic organizations has been encouraged, and practically all parts of the United States where rats occur have been reached by the educational work of the bureau.

#### PORCUPINES

Porcupines are apparently increasing in many sections, and because of the serious damage they do to forest trees and seedlings, and in some localities to corn, alfalfa, and fruits, including raspberries, apples, cherries, and



prunes; investigations have been continued to determine effective methods for their control.

### DIVISION OF FUR RESOURCES

The educational work of the bureau to develop a fuller realization of the importance of conserving fur as a valuable resource is being favorably received by conservation commissioners and societies and the National Association of the Fur Industry. Bureau representatives have attended meetings of conservationists, fur traders, and fur farmers and upon request have given information and suggestions and enlisted cooperation in protecting the sources of the fur supply. The annual summary of the fur laws, published in part to this end, was issued during the year as Farmers' Bulletin No. 1469.

#### FUR FARMING

A nation-wide study has been made of the factors influencing the production and the quality of fur from animals raised in captivity. Farms have been inspected where fur-bearing animals, including rabbits, are being raised, to obtain information on all phases of problems confronting fur farmers. Investigations of contagious diseases and parasitic infestation have made it possible for the bureau to advise farmers how to combat similar outbreaks and to improve the conduct of their operations. Fur farming has constantly developed until there are now about 2,500 fur farmers in the United States and Alaska, and about 1,500 in Canada, the majority of whom are raising silver or blue foxes. The total investment in the business is about \$30,000,000 in the United States and Alaska and about \$11,000,000 in Canada. The industry is not confined to the North American Continent, however, but has spread to European countries, where it has had a steady but quiet growth, and also to Japan.

In spite of a recent decrease in the prices paid for blue-fox skins, which has caused a number of farmers in Alaska to abandon their operations, blue-fox farming continues to flourish. A publication entitled "Blue-Fox Farming in Alaska," Department Bulletin No. 1350, issued in October, has greatly assisted blue-fox farmers and will be useful to those who contemplate engaging in the industry.

#### EXPERIMENTAL FUR FARM

The experimental fur farm at Saratoga Springs, N. Y., has been further

developed with laboratory and farm equipment to facilitate research in growing animals for fur. Scientific studies and practical tests in breeding and feeding have been conducted with red, cross, and silver foxes and martens, and the percentage of fox pups raised was higher this year than in any previous season. Lack of breeding stock of the most desirable quality, however, has made impracticable the close culling needed fully to increase vitality, prolificness, and fur quality. Experiments to determine whether the undesirable characters of a samson fox (one lacking guard hairs and thus having a nearly worthless pelt) are transmitted in crossbreeding with foxes of superior quality have progressed sufficiently to justify advice against retaining any samson foxes as breeding animals.

To determine the effect of various rations on the health of captive animals and the quality of the fur produced, studies have been continued and observations made during the mating, gestation, and whelping periods. Several years must elapse, however, before sufficient data can be accumulated to permit final analyses and recommendations. Improved methods of handling diseased animals during treatment have been devised, and studies regarding the tolerance of foxes to various drugs have been continued. A report has been prepared for publication on critical tests of tetrachlorethylene as an anthelmintic for foxes.

Many visitors from all parts of the United States and Canada have inspected the experimental fur farm since it was established at Saratoga Springs, and it is planned to issue a leaflet describing the operation and purposes of the farm for visitors and for use in correspondence, to make more generally known the work that the department is doing to assist fur farmers.

#### RABBIT INVESTIGATIONS

For many years the bureau has been called upon to supply information on raising utility rabbits, and interest in the subject has developed so rapidly of late that an assistant has been appointed to devote the major part of his time to rabbit investigations. Many of the leading rabbitries on the west coast were inspected during the past year to note the possibilities in the sale of meat and fur and the best methods of breeding, feeding, and handling rabbits. Visits also were made to raw-fur houses and dressing and

dyeing plants for the purpose of studying their methods of sorting and grading rabbit skins as well as of dressing and dyeing. Cooperation between the bureau and rabbit breeders throughout the country, with a view to assisting breeders in selling pelts and obtaining the same average price for small as for large shipments, has resulted in the organization of the Rabbit Breeders' Exchange, with headquarters in New York City.

It is planned to develop a rabbitry on the experimental fur farm, as rapidly as funds permit, with 100 breeding does, representing utility breeds, for the purpose of studying methods of feeding, breeding, and handling rabbits for the production of the best quality of meat and fur. A bulletin prepared during the year, entitled "Rabbit Skins for Fur," will be helpful to rabbit breeders and those planning to take up the work because of the improved methods detailed of skinning rabbits and preparing pelts for market. A mimeographed leaflet on chinchilla rabbits and lists of names and addresses of rabbit breeders also have been prepared for free distribution.

#### COOPERATIVE WORK

Under a cooperative agreement with the National Association of the Fur Industry part of the work accomplished on the distribution and protection of fur-bearing animals will be published with maps and photographs in the official organ of that association. The preliminary work in assembling data regarding the annual catch of fur animals has demonstrated the need of considerable improvement in obtaining statistics. Without accurate data kept by each State on the number of skins taken, it will be impossible to estimate the number of fur bearers trapped annually in the United States. Their total value is very great, and the cooperation of the bureau with other agencies should result in a marked increase in fur production.

In cooperation with the Bureau of Public Roads a practical type of fox den and pen has been designed, and more than 1,000 copies of blue prints of it have been mailed to inquirers.

#### DIVISION OF FOOD HABITS RESEARCH ECONOMIC ORNITHOLOGY

The major work of this division is connected with problems of current importance in economic ornithology, in the solution of which both labora-

tory research and field surveys are employed.

#### BLACKBIRDS

The study of the relation of blackbirds to the rice crop of the Gulf coast, begun during the preceding fiscal year through a cooperative arrangement between rice growers of Louisiana and the Biological Survey, was continued and field work completed. During the summer of 1925 the fact was established that a material reduction in the number of blackbirds in the area is impossible during the growing and harvest seasons. The series of experiments carried out in the spring of 1926 to learn whether control by poisoning would be effective during the early part of the planting season, a period of comparative food scarcity, were by no means consistent although more satisfactory than those of the late spring of 1925. The area in which blackbird damage is severe enough to warrant the necessarily great expense of control is confined largely to a very narrow zone of coastal plain along the southern border of the rice area. To reduce creatures as nomadic as blackbirds in such a limited area would require operations in the whole region, over much of which blackbirds are not destructive enough to require drastic control, and in some situations they may even be beneficial to the farmer. The conclusions reached were that poisoning operations should be limited to the narrow zone of severe damage; that the use of poisoned baits at sprouting time has a certain deterrent effect on the birds; and that nothing but the use of firearms can curtail losses during the ripening period and harvest.

A manuscript was completed during the year on local control of birds, with special reference to crop protection.

#### BOBOLINKS

The relation of bobolinks to rice in the limited acreage still devoted to that crop in the South Atlantic States was the subject of an investigation during August, 1925. It was found that the damage may be as great as 30 per cent of the stand.

#### FISH-EATING BIRDS

Investigations of the food habits of cormorants and other fish-eating birds in Minnesota and North Dakota, begun in the previous fiscal year, were completed. The stomachs collected



have been examined and determination made that no serious damage to food and game fishes can be charged against cormorants in Minnesota, except at Lake of the Woods, where a concentration of the birds warrants local control measures. No damage requiring extensive control was discovered in the case of any other fish-eating bird in Minnesota or North Dakota. Stomachs examined included those of the great blue heron, the American bittern, four species of gulls, four of terns, the kingfisher, four species of grebes, and the loon.

#### INCREASING BIRD ENEMIES OF INSECT PESTS

An attempt to increase the number of birds as a method of controlling nut weevils has been started in co-operation with the Bureau of Plant Industry at the chestnut orchard maintained on the experimental farm at Bell Station, Glenn Dale, Md. Nest boxes, bird baths, and other bird-attracting devices have been installed to increase the number of birds, the aid of which is sought in the control of the weevils.

During the year a Farmers' Bulletin entitled "Homes for Birds" was issued, and this and a Farmers' Bulletin entitled "How to Attract Birds in Northeastern United States" were published also in revised form.

#### EXAMINATION OF STOMACHS

In the laboratory, examination was made of 871 stomachs of birds, 110 of mammals, 93 of toads, and 10 of alligators. In addition 2,296 pellets of hawks and owls were examined, nearly half of which were of marsh hawks collected for a study of their food habits in relation to quail in southern Georgia and northern Florida. Of the bird stomachs examined, those of quail, English sparrows, shorebirds, blackbirds, and fish eaters predominated.

Examinations also were made of stomachs of birds submitted by persons interested in the food habits of game or insectivorous species in Louisiana, South Carolina, Arkansas, Iowa, Illinois, Massachusetts, and Alberta. Nearly half of the mammal stomachs examined were of deer from the Kaibab National Forest, where large numbers have starved because they have increased beyond the capacity of their range to produce the food required to maintain them.

In the course of the year department bulletins were published entitled

"Food Habits of the Vireos," and "Food of American Phalaropes, Avocets, and Stilts," based on laboratory analyses of stomachs. Manuscripts also have been prepared for Farmers' Bulletins on the starling in its relation to agriculture and on propagation of migratory and upland game birds.

#### FOOD HABITS OF REPTILES AND AMPHIBIANS

In addition to the completion of the examination of stomach material of toads and the compilation of the data obtained therefrom, work has been started on the examination of reptile-stomach material. A series of alligator stomachs obtained on muskrat marshes in Louisiana yielded interesting information on the food habits of these reptiles. Manuscript was submitted for a department bulletin on toads in relation to agriculture, horticulture, and forestry, and a mimeographed circular, "Facts about Snakes," was issued.

#### FOOD RESOURCES OF WILD FOWL

Surveys of the food supply for wild fowl in lakes and marshes were continued in the upper peninsula of Michigan and in Minnesota, and similar work was begun in the Upper Mississippi River Wild Life and Fish Refuge. In Louisiana, a study was made chiefly in the vicinity of the Rainey Wild Life Refuge of the effects of a prolonged drought upon aquatic vegetation attractive to wild fowl, with the resultant increase of the salinity of coastal waters. Additional surveys of wild-duck food resources were made on the delta of the Mississippi River in cooperation with the Louisiana Department of Conservation, and at points in Mississippi, Georgia, Florida, North Carolina, Arkansas, Texas, Maryland, and Virginia. Survey was made also of a number of military reservations in Louisiana about to be disposed of by the War Department to determine their utility as bird reservations, particularly for migratory waterfowl.

An inspection was made of Currituck Sound, N. C., to learn the cause of the failure of the food supply of wild fowl. A decided increase of the salinity of these waters had occurred, and investigation showed it to be due chiefly to the influx of salt water through the Chesapeake and Albemarle Canal. The removal of locks from this canal, when it was straightened, widened, and deepened a few



years ago, apparently has facilitated the flow of salt water into the sound, so that its waters, which for generations have been one of the most important wintering grounds for wild fowl, are becoming too salty for the growth of their food plants, and in proportion to the reduction in food supply are losing their great population of wild fowl, one of the most important economic resources of the region. The Biological Survey is co-operating with all individuals and organizations interested in checking the destruction by salinity of this most important feeding ground for migratory wild fowl.

A mimeographed leaflet on "The Care of Swans" was issued during the year and manuscripts were completed for publications on the relation of wild life to land values and on game birds suitable for naturalizing in the United States.

#### COOPERATIVE QUAIL INVESTIGATION

The beginning of the third year of the cooperative quail investigation in southern Georgia and northern Florida shows important progress in the study of the life history of the bobwhite quail and of factors governing its abundance and welfare. This has been made possible through the continued hearty cooperation and financial aid of interested sportsmen.

During the year a total of 100 quail nests were intensively studied and information obtained as to the cause of destruction of a large proportion of them. Approximately 80 per cent of the nesting attempts were found to be failures, although by repeated efforts many of the pairs finally succeeded in raising broods.

As an aid to the study of the covey relationships and movements of quail, 833 native wild quail were trapped and banded as well as 1,000 other birds that were imported and liberated for restocking purposes by local sportsmen. Records of more than 200 returns from these birds indicate that the species have no extensive movements—fully 50 per cent having been shot or recaptured within a quarter of a mile of the point where banded.

As a basis for a study of food habits, 487 crops and gizzards of quail have been collected and examined. Studies have been continued of the various factors that influence the natural food supply, as cultivation and fires, and experimental plantings of desirable foods have been made to develop information helpful to those

wishing to supplement the natural supply for these birds.

Propagation experiments are being conducted with a limited number of quail, and observations made upon their diseases as well as their behavior in captivity. Correlated with this has been the examination of many quail shot by sportsmen, with the object of determining the prevalence of both internal and external parasites.

Series of experiments were carried on during April to ascertain the most effective and economical means of controlling cotton rats on quail preserves, previous studies having shown that these rodents destroy quail eggs as well as compete with the quail for food. Interesting information was gathered as to the benefit at times derived from certain hawks that prey upon cotton rats. Eleven hundred pellets of marsh hawks, picked up on a heavily stocked quail preserve, proved on analysis to contain among other items the remains of 925 cotton rats and only 4 quail. Cotton rats are important destroyers of quail eggs, and results of examination of these pellets indicate that the marsh hawk may be a decided factor for the good of the quail.

A mimeographed report of progress was issued in the fall of 1925, covering such topics as mapping large quail preserves of the region, preparing specimens for studies of plumage and molt, and collecting and preserving material for a study of food items.

#### DIVISION OF BIOLOGICAL INVESTIGATIONS

The index files of information of this division, now numbering approximately 1,600,000 cards containing data on the distribution, migration, and life histories of North American birds and mammals, have received many additions. These are constantly used in answering requests for information concerning the 3,500 forms of birds and the 2,500 of mammals known to inhabit the continent north of Panama and serve as a basis for the administration of much of the work of other divisions of the bureau.

#### REVISIONS OF MAMMAL GENERA

A revision of the ground-squirrel genus *Citellus* is practically completed. This group is of great economic importance because of its colonial habits, the number of the species, and the fact that the members inhabit diverse types of country and consequently damage

a great variety of crops. Certain of the species are carriers of bubonic and pneumonic plagues and spotted fever. A thorough understanding of the distribution, habits, and life histories of the numerous forms is highly desirable, as this information has a direct practical usefulness not only with regard to their relations to crop growing but also to the public health.

Work on a revision of the long-tailed shrews (*Sorex* and related genera) has been completed and the manuscript is nearly ready for the printer. Progress was made also on a revision of the kangaroo rats of the genera *Dipodomys* and *Microdipodops*, a group of economic importance. A revision of the species of *Phenacomys*, a group of small rodents, was in press at the end of the year, and similar work on the related genus *Synaptomys* is nearly ready for publication.

#### BIOLOGICAL SURVEYS OF STATES

With the exception of work in Florida, no State surveys were made during the year. In April and May a somewhat detailed examination was made of a considerable extent of Florida coast not before worked, and important biological information obtained. Definite arrangements are in progress with State institutions for the publication of an annotated list of the birds of the State, and the preparation of this work is well under way. Other reports comprising annotated lists resulting from surveys of States, other than those already published, are as follows: In press—Mammals of North Dakota; ready for publication—Mammals of New Mexico, Mammals of Oregon, Birds of Texas, Birds of New Mexico, Birds of Washington; in preparation—Mammals of Washington, Birds of North Dakota.

#### NATURAL-HISTORY EXPLORATIONS IN ALASKA

The early part of the fiscal year witnessed the completion of the co-operative expedition of the Biological Survey and John C. Phillips to the western part of the Alaska Peninsula and to Unimak, the easternmost of the Aleutian Islands. More detailed knowledge of the fauna of the region was desirable, as it is in part within the Aleutian Islands Reservation and is the home of a variety of important species of mammals and a breeding place of both resident and migratory birds. The expedition obtained valuable information concerning the resi-

dent game and fur-bearing animals, as well as on the breeding birds.

In the spring of 1926, another expedition was sent to Alaska partly for the purpose of banding migratory wild fowl. The results of the expedition sent in 1924 to the Yukon Delta have emphasized the value of banding as a means of ascertaining the lines of flight and the wintering grounds of birds breeding in particular areas, knowledge that is significant in the formulation of protective measures.

#### BIRD MIGRATION

Reports on the migration of birds have been received from about 335 volunteer observers, well distributed over the United States and the southern part of Canada, and especially valuable from the fact that many of the observers have been making the reports over a long series of years. Partly based on these reports, a study of the distribution and migration of the swallows is in preparation and has seen substantial progress during the year. By means of special field studies, significant data on the seasonal movements and abundance of several groups of economically important birds, notably the migratory waterfowl and the shorebirds, have been obtained.

#### BIRD CENSUSES

Reports of enumerations of birds found breeding on certain measured areas, usually typical of occupied farmlands, were received from about 100 volunteer observers in many parts of the country. Many of these came from cooperators who have reported on the same areas during previous seasons, and thus are extremely valuable, as such reports will eventually make it possible to prepare an estimate of the total bird population of the country.

#### BIRD BANDING

The past fiscal year marks the sixth and most successful year in bird banding since the work was assumed by the Biological Survey. The number of active cooperators shows a slight increase over last year, being now 1,134, of whom 98 are working in Canada. The total number of birds banded during the year was 68,418, an increase over last year, bringing the total number banded since 1920 to more than 200,000. The number of returns received during the year was 3,351, and the number since 1920 more



than 11,000. Banding cooperators are organized into four regional associations, and their sustained interest in the work has been particularly noted at their annual meetings, two of which were attended by a representative of the Survey. A publication for the use of the cooperators, "Trapping Ducks for Banding," was issued during the year as Department Circular No. 362. A report is in preparation summarizing the returns recently compiled in certain groups of birds.

#### REQUIREMENTS OF BIG GAME

During July, 1925, a representative of the bureau was engaged in making field studies of the life habits of the mule deer of the Grand Canyon National Game Preserve in Arizona, where a serious condition has developed because the deer have increased beyond the available winter food resources. Further examination of the animals and their environment was made by another assistant of the bureau during the last week of April and the first week of May, to obtain data reflecting spring conditions.

#### HABITS OF INJURIOUS RODENTS

Field studies of the relation of rodents to agriculture, horticulture, and forestry, which have been under way for several years, have been continued. They include the maintenance and observation of a series of fenced areas inclosing various types of forage, in which different controlled conditions allow for recording the effect produced by the inclusion or exclusion of various rodents and of livestock. Other rodent studies concern the porcupines, jack rabbits, ground and tree squirrels, pocket gophers, and pocket mice. Investigations also have been made of a few instances in which beavers have become troublesome, and it has been possible to trap and remove the surplus animals to more desirable localities.

#### EXPERIMENTS WITH TROPICAL GAME BIRDS

Attempts have been made during the past two years to introduce and acclimatize certain tropical game birds, including tinamous, curassows, ocellated turkeys, and chachalacas on Sapelo Island, Ga. The chachalacas are breeding freely in various parts of the island and the curassows are showing signs of a desire to breed. Experiments with other birds so far have been unsuccessful.

#### MIGRATORY WILD FOWL IN MEXICO

Many conservationists and others have been urging the negotiation of treaties with Latin American countries for the protection of species of birds that winter south of the United States, similar to the migratory-bird treaty with Great Britain, which covers the protection of birds that migrate between the United States and Canada. In order to gather information on which diplomatic representations might be based, a biologist was sent to Mexico in January where he spent more than two months studying conditions on the principal wintering grounds of migratory waterfowl. It was learned that migratory game birds, especially ducks, spend the colder months in great numbers in the principal lakes and marshes as far south as the valley of Mexico, and that they are in urgent need of better protection, as they are decreasing in that section because of the slaughter for market that has been carried on with little restriction for many years. Mexican diplomatic and game officials have shown a desire to cooperate with the United States in game protection, and the matter is to be given further consideration.

#### DIVISION OF ALASKA INVESTIGATIONS GAME IN ALASKA

Through representation on the Alaska Game Commission, the Biological Survey is in close touch at all times with the work of the commission and has been able to assist it in many ways during the first year of its operations. The old game law was in force until August 9, 1925, but on August 10 the regulations under the new law became effective. With one exception all the employees of the Biological Survey who had been engaged in the enforcement of the Alaska game law were reappointed. The commission held its second annual meeting in Juneau from February 3 to 24, 1926, with all members present. Most of its recommendations for changes in the regulations were approved and promulgated by the Secretary on May 18, 1926. These were published on May 18 by the game commission in its circular No. 2 entitled "Laws and Regulations Relating to Game, Land Fur-bearing Animals, and Birds in Alaska."

The best evidence of the public approval of the new game and fur law in Alaska is the strong enforcement of its penalties by the local courts. Of



55 cases brought before the courts up to January 31, 1926. 43 defendants pleaded guilty, 10 were convicted of the charges against them, and only 2 were acquitted. The courts ordered the confiscation from aliens and sale of 21 rifles, 9 shotguns, and 3 pistols. The following sentences imposed by the courts are of such severity as to render game and fur law violations unpopular in parts of the Territory where wardens can be maintained:

Possession of poison for killing foxes drew a fine of \$25; killing geese out of season, \$25; possession of skins of fur bearers caught before the season opened, from \$25 to \$100; trapping without a license, \$25; trapping beavers out of season, \$25 fine and 60 days in jail in one case and 90 days in jail in another; killing and possessing a female deer, \$50; killing mountain sheep in a game refuge on the Kenai Peninsula, a fine of \$250 and 90 days in jail. One registered guide had his license revoked by the commission for permitting his party to kill game illegally.

Proceeds received from licenses and other sources during the year and totaling \$18,764.31 were divided equally between the Federal Treasury and the Territorial school fund. Although the funds for field work have been very inadequate for the proper protection of the valuable wild-life resources of Alaska, excellent results have been accomplished under the existing limitations in the short period the new act has been in operation.

#### BOAT PATROL WORK

As enforcement of the law is primarily through a patrol over the wide expanses of the Territory where transportation facilities are poor or entirely wanting, one of the first problems confronting the commission was that of, in part at least, overcoming this difficulty. The cabin cruiser *Sea Otter* continues to patrol the waters of

southeastern Alaska. In October the *Marten*, belonging to the Biological Survey but loaned to the commission for use on upper Cook Inlet, was wrecked when the engine was disabled during a storm, the anchor dragged, and the vessel drifted ashore. At some sacrifice of other activities, the commission has been able to equip and put into service the *Seal*, a seaworthy motor cruiser 68 feet in length. It will cruise in the water embracing the Alaska Peninsula and adjacent islands, the Aleutian Islands, and Bristol Bay, and in summer along the Bering Sea coast as far north as the mouth of the Kuskokwim River. The region is noted for the severity and uncertainty of its weather, and no vessel less able could attempt the work.

#### ALASKA FUR ANIMALS

The fur crop, always an important source of revenue to Alaska, provides the only income from vast areas. Unfortunately, the breeding stock has been considerably reduced by overtrapping, but with vigorous enforcement of the new law the production can be greatly increased. As game is the only fresh meat to be had in large portions of the Territory, and as big-game hunters and lovers of the outdoors are each year visiting Alaska in greater numbers, increased efforts will be needed to maintain the big game and build up its numbers to the limits of the ranges.

#### SHIPMENTS OF FUR

Reports for the calendar year 1925 made to the Alaska Game Commission show the total value of skins of land fur-bearing animals exported from the Territory to be about \$2,500,000, an increase of approximately \$500,000 over the preceding year. Shipments of muskrat skins alone more than doubled. The number and value of the principal pelts were as follows:

*Number and value of the principal pelts of land fur animals shipped from Alaska from January 1 to December 31, 1925*

Kind of fur	Number of skins	Value	Kind of fur	Number of skins	Value
White fox.....	16, 658	\$583, 089	Marten.....	3, 647	\$72, 940
Mink.....	59, 504	416, 528	Otter (land).....	3, 265	62, 035
Muskrat.....	395, 142	335, 870	Silver fox.....	577	51, 930
Red fox.....	19, 489	331, 313	Cross fox.....	2, 248	44, 960
Blue fox.....	5, 493	273, 710	Weasel (ermine).....	13, 418	10, 734
Lynx.....	7, 920	134, 640	Black (glacier) bear.....	930	6, 510
Beaver.....	3, 949	78, 980	Polar bear.....	190	5, 700

**IMPROVEMENT OF REINDEER HERDS**

In furtherance of studies of the reindeer herds and observations of the range and of the abundance and distribution of forage plants, local agents of the bureau have visited the herds during round-ups and assisted native and white owners in solving problems for the improvement of herd management and finding a more ready market for surplus stock. A report, Department Bulletin No. 1423, "Progress of Reindeer Grazing Investigations in Alaska," was in press at the end of the year.

**PROPOSED RANGE EXTENSIONS**

An extended trip was made during the year to the upper Kantishna country to determine its suitability for the location of a reindeer herd and its possibilities as a stock driveway. It was found that the area was not suitable for holding a herd, but that it could be used in driving stock across from the Kuskokwim Valley to the Alaska Railroad, thus avoiding passing through the Mount McKinley National Park. The matter of urging owners of reindeer herds to move them to the ranges near the Alaska Railroad so as to have better marketing facilities for surplus stock is being taken up with the railroad officials, and a satisfactory cooperative understanding probably will be worked out.

**ALEUTIAN ISLANDS**

Practically all the islands in this reservation best adapted to the purpose, 76 in number, are now occupied for fur farming, principally with blue foxes. No further permits have been issued during the year. The sheep-grazing industry there is progressing with improved prospects, through agreements with the department whereby one company operates on the western end of Unalaska Island and another operates on Unalaska and Umnak Islands. Other islands in this reservation are being carefully investigated with a view to occupying them for sheep grazing.

**REINDEER EXPERIMENT STATIONS**

Arrangements are being made for establishing the main reindeer experimental station of the bureau at the Alaska Agricultural College near Fairbanks. It is planned to conduct the work at this station in cooperation with the agricultural college. This will help solve many problems affect-

ing the reindeer industry, and young Alaskans can be trained for the reindeer business. At Broad Pass a substation may be established where herd control on interior ranges can be studied and other important problems solved. Officials of the Alaska Agricultural College and of the Alaska Railroad have expressed a desire to cooperate in every way possible in the establishing of these experiment stations.

**TRANSPORTATION OF REINDEER FOR RESTOCKING**

Officials of Canada have begun an investigation in connection with a project for stocking northern Canada with reindeer from Alaska and have sent two representatives to Alaska to get a practical knowledge of reindeer herd management and of reindeer forage plants under the guidance of Biological Survey experts. Another purpose of the Canadian representatives is to get information on the best breeding and grazing grounds over which to make a drive of approximately 2,000 reindeer to the Mackenzie River delta region. It has been estimated that such a drive would take about three years and would cost about \$100 for each animal. This drive is planned to try to provide reindeer to enable the Eskimos of northern Canada to become self-supporting. The Biological Survey is giving all the cooperation possible in this undertaking.

**DIVISION OF GAME AND BIRD RESERVATIONS**

Federal reservations administered by the Biological Survey for the conservation of wild life now number 72, including two bird refuges added by Executive order during the year, and the Upper Mississippi River Wild Life and Fish Refuge, the acquisition of lands for which is now well under way.

**BIG-GAME PRESERVES**

Four of the big-game preserves are fenced areas. Three of them were originally established primarily to save the buffalo from threatened extermination, and all are now being developed as game farms for the buffalo, antelope, mountain sheep, and other big game that may be used for restocking purposes. The winter elk refuge is of vital importance, insuring as it does the saving from starvation during severe winters of large num-



bers of elk of the southern Yellowstone and adjacent regions.

The most noteworthy activity on the big-game preserves during the year was the disposal of a number of surplus animals, especially elk from the National Bison Range, Mont., and the Wind Cave National Game Preserve, S. Dak., where they had increased until they threatened serious injury to forage in the preserves. From the four fenced preserves, surplus game animals sold during the year netted the United States Treasury \$24,246.65.

Big-game animals on reservations administered by the bureau, with the exception of the antelope, have increased notably during the last 10 years. The increase in mountain sheep from the 12 (4 rams and 8 ewes) introduced on the National Bison Range in 1922 to about 50 in 1926 shows in a gratifying way what can be expected of these splendid game animals when accorded proper protection. Antelope, which had increased from 47 in 1916 to 91 in 1921, unfortunately through losses in 1922 and 1923 were reduced to 16, mainly by sudden inroads of predatory animals during stormy weather, thus again affording a striking illustration of the necessity of controlling such game-and-stock destroyers. With the better control of the predatory animals that has been initiated antelope are again increasing, and with a part of the fawns captured in Nevada in 1924 for restocking purposes, now number 26. Of 12 young antelope captured in Nevada at the same time and transplanted in Grand Canyon National Park, Ariz., under the auspices of the Biological Survey, 3 have died but the addition of 3 fawns born in the spring of 1926 restored the original number. The total number of big-game animals now on reservations administered by the bureau is about 1,530.

#### NATIONAL BISON RANGE, MONT.

The numbers of big-game animals on this range at the close of June were approximately, as follows: Buffalo, 566 (including 116 calves); elk, 257; mule deer, 102; white-tailed deer, 35; mountain sheep, 50; and antelope, 3. During the year 66 buffalo were disposed of as meat and 7 were shipped alive to public parks.

The overcrowded condition that had developed on this range was materially relieved by the removal of 388 elk in February, before the grass began to grow. The sale of these animals to a grazing and breeding asso-

ciation in Massachusetts necessitated the construction of over 5 miles of fencing for their capture. The capture and removal of these elk was the greatest operation on record in this country of handling big game on a wholesale scale. Only a small number were lost during the operation.

#### WIND CAVE NATIONAL GAME PRESERVE, S. DAK.

Game animals on the Wind Cave National Game Preserve, S. Dak., are as follows: Buffalo, 143 (including 21 calves); elk, approximately 130; antelope, 15. The antelope are increasing. During the year 10 buffalo (5 bulls and 5 cows) and 62 elk were shipped alive to various points.

#### ELK REFUGE, WYO.

The year was favorable for hay production, and about 950 tons were harvested on the Elk Refuge, and this was supplemented by approximately 600 tons raised on adjacent lands purchased by the Izaak Walton League of America. The State of Wyoming also provided a considerable tonnage to be fed to elk on private lands in Jackson Valley. Twenty-two acres of oats were harvested, yielding 1,177 bushels of grain for use on the refuge.

The past winter in Jackson Hole Valley was one of the mildest recorded in many years. There was only about one week of severe weather, and light falls of snow in January and early in February were soon melted by warm south winds, after which the refuge was practically free from snow. Approximately 4,500 elk wintered on the refuge and on the neighboring ranches and foothills. With sufficient forage on the meadows and pasture lands to supply their needs it was not necessary to feed them at any time. Only six were found dead during the period they were on the refuge and in the vicinity.

Owing to the mild winters since that of 1921-22, and the comparatively few elk killed by hunters—less than 1,000 in 1925—the southern Yellowstone herds have been increasing so rapidly that there is now an unwieldy surplus. Counts have indicated that under such conditions the rate of increase in the herds is about 25 per cent a year. On this basis it is estimated that on June 30, 1926, these herds numbered probably 30,000 animals. Winter range and forage is the limiting factor for elk, and the bureau considers 20,000 the maximum number that under pres-



ent conditions can find sufficient food in this district to survive the severe winters that frequently recur.

It is estimated that only about 650 tons of hay will be harvested on the refuge this season, because of lack of rain since the middle of May, but with that furnished by the State of Wyoming and the Izaak Walton League and an accumulated supply, well over 4,000 tons will probably be available. This should carry 12,000 elk through a severe winter, but under the changing conditions an even greater number might visit the refuge. Additional winter range and forage, properly located, is desirable for the maintenance of even a reasonable number of elk, but it is obvious that sufficient winter feed can not be supplied for ever-increasing numbers. If the present rate of increase is unchecked, frightful suffering and mortality will be inevitable during the first severe winter. Some of the surplus elk might be used for restocking purposes, but the most practicable means of removal seems to be through better provision for regulated hunting.

#### **SULLYS HILL NATIONAL GAME PRESERVE, N. DAK.**

During the year 11,184 persons visited Sullys Hill National Game Preserve, N. Dak., its accessibility having been increased with the practical completion of a new road, known as the Devils Lake-Fort Totten Highway, which passes through about 2 miles of the preserve. Animals maintained here include 15 buffalo (including 3 calves), 41 elk (including possibly 10 calves, a definite count of which can not be obtained until later in the year), 2 antelope, and 1 deer. During the year 1 buffalo died, a cow 23 years old that was presented to the preserve by the city park authorities of Portland, Oreg., when the herd was established in 1918. Four elk were sold for meat and 12 were shipped for breeding or exhibition purposes. Game birds permanently on this interesting preserve include 9 Canada geese, 3 wood ducks, 3 golden pheasants, and 7 Chinese pheasants.

#### **NIORRARA RESERVATION, NEBR.**

Big-game animals on Niobrara Reservation on June 30 were as follows: Buffalo, 71 (including 14 calves); elk, 92 (including about 20 calves); antelope, 6; white-tailed deer, 1. The buffalo and elk are in a thriving condition. Four of the antelope died late

in 1925, but the six animals remaining appear to be doing well.

#### **BIRD REFUGES**

The bird refuges administered by the bureau afford feeding and resting grounds for migratory waterfowl and protected breeding places for many interesting game and nongame species that are being reduced in numbers or threatened with extermination. The Brevard Island Reservation, on the east coast of Florida, and the Johnston Island Reservation, in the Hawaiian Group, were established during the year. Brevard Island has become an important breeding place for brown pelicans, which have been driven from their old home on Pelican Island in Indian River. The Johnston Island Reservation, consisting of Johnston Island, about half a mile long and a quarter of a mile wide, and Sand Island, about half as large, is about 500 miles south of the chain forming the main Hawaiian Group and is the breeding ground for thousands of shearwaters and terns and hundreds of other sea birds.

#### **UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE**

Under authority vested in the department by act of Congress and the passage of enabling acts by the legislatures of Minnesota, Wisconsin, Iowa, and Illinois, examination and purchase of lands for the Upper Mississippi River Wild Life and Fish Refuge was begun in the fall of 1925. An office has been established at Winona, Minn., with a superintendent in charge of a small technical force engaged in land valuation and purchase activities. At the close of the year, organization had been completed and much preliminary examination work accomplished. Lands have been acquired or were in process of acquisition to the extent of approximately 31,500 acres, including, in addition to purchases, islands already in the possession of the Government and areas donated for the refuge.

#### **MIGRATORY-BIRD TREATY AND LACEY ACTS**

In the administration of the migratory-bird treaty act, protecting birds migrating between the United States and Canada, and the Lacey Act, regulating interstate commerce in game and the importation of foreign birds and mammals, much has been accomplished, although the inadequate war-

den force is a serious detriment to the work. Continued cooperation on the part of State game officials, United States district courts, United States district attorneys, and others interested has resulted in increased enforcement of these laws. Arrests of offenders and subsequent court action have had a wholesome effect in many places in bringing about a proper attitude toward the law, and educational work also has increased appreciation of its purposes. Every effort has been made to urge that contemplated drainage projects be wisely considered, with a view to preventing needless destruction of the breeding, feeding, and resting places essential to the perpetuation of the species sought to be protected by the Federal laws. The results of drainage and the reduction of water areas after a series of dry years are having a marked effect on the wild fowl of the West.

#### THE ADVISORY BOARD

The Migratory-Bird-Treaty-Act Advisory Board held its annual meeting in Washington on December 10, 1925, and considered proposed changes in the migratory-bird regulations submitted to it by the Secretary of Agriculture. The changes subsequently adopted by the Secretary and approved by the President were as follows:

A later open season for waterfowl was fixed in the States of Illinois, Indiana, Kentucky, New Mexico, California, and the eastern portion of Washington, and on mourning doves in South Carolina. These changes should prove beneficial in permitting young birds of the year to mature more fully and in avoiding the spoilage that frequently occurred in the earlier and warmer season. A separate season was prescribed in Massachusetts for the counties of Nantucket and Dukes (the islands of Nantucket and Marthas Vineyard), which are at such distance from the mainland that local conditions make desirable an open season different from that for the rest of the State. The season on black-bellied and golden plovers was closed indefinitely, as the golden plover appears to be decreasing and the black-bellied species shows little if any increase. The bag limit on Wilson snipe, or jacksnipe, was reduced from 25 to 20 a day, on sora from 50 to 25 a day, and on gallinules and rails (except sora), to 25 in the aggregate of all kinds, but not more than 15 of any one species. The daily bag limit on coots was fixed at 25.

#### PERMITS TO KILL INJURIOUS BIRDS

Under authority of Article VII of the migratory-bird treaty and of regulation 10 thereunder, orders were issued effective in the States of California, Connecticut, Kansas, Michigan, and New York, permitting the killing of certain migratory birds when found to be injurious to valuable fish life. These were based on the results of extensive investigations conducted by the Biological Survey, which disclosed that birds of the species involved—great blue herons, bitterns, and mergansers—were destructive to trout and other game fish in some localities. These orders will prevent the depredations of these birds without detriment to the future of the species.

#### VIOLATIONS OF THE TREATY ACT

There were 415 cases of violation of the migratory-bird treaty act pending on July 1, 1925, and during the fiscal year 540 additional cases were transmitted for prosecution. Of the total of 955 cases, 583 were disposed of as follows: 409 by conviction, 79 by dismissal, 7 by jury verdicts of not guilty, 9 by the operation of the statute of limitations, 49 were not-prossed, 5 abandoned, 2 quashed by the court, 1 by sustaining a demurrer, and 4 closed by death of the accused. Nine cases tried before juries resulted in convictions.

Sixty-two cases reported by Federal wardens were not forwarded for prosecution because of youthfulness of the accused, insufficient evidence, adequate fines having been imposed in State courts, or other valid reasons. Many cases were turned over to State authorities for prosecution where violations of the State game laws were involved, and the resulting fines aggregated \$6,495.97. In Federal courts jail sentences were imposed in 13 cases, and the fines ranged from \$1 to \$500, and, including costs, which in many cases exceeded the fines, amounted to \$10,219.65. The fines averaged \$28.04, as against \$22.12 in 1925.

Convictions in Federal courts were distributed as follows: Alabama, 10; Arkansas, 9; California, 5; Delaware, 6; Florida, 17; Georgia, 20; Illinois, 78; Indiana, 10; Iowa, 9; Kentucky, 2; Louisiana, 26; Maine, 8; Maryland, 14; Massachusetts, 1; Michigan, 3; Minnesota, 32; Mississippi, 6; Missouri, 15; Nebraska, 3; New Jersey, 2; New Mexico, 4; New York, 2; North Carolina, 11; North Dakota, 3; Ohio, 1; Oregon, 1; Pennsylvania, 3;



Rhode Island, 3; South Carolina, 4; South Dakota, 17; Tennessee, 18; Texas, 39; Virginia, 15; Washington, 8; and West Virginia, 4; total, 409.

Migratory waterfowl, aigrettes, and mounted birds unlawfully killed or possessed and having a potential market value of approximately \$12,000 were seized during the year, more than double the value of similar seizures in the preceding year. Seized birds that could be utilized as food were donated to public hospitals or to public charitable institutions. The nature of the violations and the penalties imposed in each case will be noted from the following selected cases terminated during the year:

Two offenders in Illinois, for hunting ducks in the close season, were required to remain in jail 7 days each pending the payment of their fines; another for similar default, and charged with the same offense, spent 4 days in jail; and still another charged with selling ducks, 25 days; in Virginia one offender charged with trapping ducks was imprisoned 5 days. Fifteen cases were terminated by the imposition of jail sentences.

Hunting ducks after sunset in Delaware brought a fine of \$300, and in New Jersey \$500, as this was the violator's third offense and the maximum fine was imposed. In Virginia trapping ducks cost two offenders, respectively, \$100 and \$370. In Georgia two cases of shooting doves out of season resulted in fines of \$150 each. In Missouri two cases of hunting ducks in the close season brought fines of \$100 each and a similar case in Ohio \$50. In West Virginia killing ducks from a motor boat cost a fine of \$50, and in Michigan three cases of killing coots from a motor boat cost in each \$50. In Arkansas it cost two offenders \$15 each for hunting migratory wild fowl from an airplane. In Tennessee two fines of \$25 were imposed for exceeding the bag limit. In Florida the possession of plumes of egrets and snowy herons cost \$450, and in Illinois the possession of aigrettes cost \$300. In Illinois the possession of wild ducks in storage during the close season carried a penalty of \$150 and court costs. In California, Louisiana, and two cases in Texas the sale of wild ducks cost the offenders \$100 each, and in Mississippi the offer to sell a wood duck cost \$50.

From the foregoing instances it is evident that many Federal judges are in sympathy with the law and do what they can to help enforce it.

## DUCK SICKNESS

During the fall of 1925 an extensive mortality occurred among the wild ducks and some other migratory wild fowl at Malheur Lake in Oregon, and at Tule Lake and on the Sacramento Valley marshes in California. The number of dead ducks at one time in Tule Lake was estimated at about 50,000. The United States game warden with the cooperation of experts of the Bureau of Animal Industry and of the University of California tried to determine the cause, but without success. The sickness of the ducks was similar to that caused by alkali poisoning, but the surroundings strongly indicated the presence of some disease other than that. Investigations will continue to determine the cause of this menace to wild fowl.

## INTERSTATE COMMERCE IN GAME

Six cases involving violations of the Lacey Act were reported for prosecution, and four of them were disposed of in Federal court during the year, the penalties aggregating \$50. Cooperation with State authorities in the enforcement of State laws with reference to fur animals was more extensive than heretofore, and 2,448 cases, as compared with 1,000 for the previous year, were referred to State authorities as a result of activities of Federal wardens working alone or with State game wardens. In 330 of these cases disposed of in State courts, fines and costs aggregating \$14,850 were assessed and 240 contraband beaver skins were seized by the States on information supplied through the Federal warden service. Jail sentences of 60 days each were imposed on two offenders, a third was committed in default of a \$475 fine, and another, a minor sentenced to the industrial school, was placed on parole. During the year, 66 Federal investigations were closed mainly for the reason that the shipments were not made illegally. At the close of the year 253 cases were pending.

Special investigations in cooperation with State authorities have again been conducted in three raw-fur-buying centers, New York, Chicago, and St. Louis. The large volume of illegal traffic in furs and the many subterfuges resorted to by violators emphasize the necessity for an increased warden force and for additional Federal legislation to supplement that of the States, if adequate control of illegal interstate traffic in furs is to be maintained.

## COLLECTING AND OTHER PERMITS

Permits issued during the year to collect migratory birds and their nests and eggs for scientific purposes numbered 197, which, with 1,221 valid until revoked and 1 revoked, made a total of 1,417 permits outstanding. Scientific-possession permits, issued mainly to taxidermists, numbered 287. For the possession and sale of waterfowl for propagating purposes 3,298 permits were in force, and 105 permits were issued authorizing 87 persons to capture waterfowl for propagation.

## IMPORTATION OF FOREIGN BIRDS AND MAMMALS

Permits issued for the importation of foreign birds and mammals numbered 1,033, an increase of 52 over last year, and the shipments inspected increased from 239 to 295. Eight additional permits were issued for the entry of 109 miscellaneous birds at Honolulu, Hawaii. The total number of birds imported was 471,667, of which 11,683 were entered without permits.

## MAMMALS

Permits for the importation of mammals included 7,809 foxes from Canada, a decrease from 1925. Following are the figures for the past five years: 8,424 in 1925, 4,871 in 1924, 2,753 in 1923, 2,064 in 1922, and 1,574 in 1921. An unusual number of black bears were imported from Canada during May and June for exhibition purposes, permits for 97 having been issued for shipments originating in four Provinces and consigned to widely scattered points in 10 States.

One case of entry of a prohibited species was reported during the year, a mongoose presented by a sailor to the Zoological Society of San Diego, Calif., and killed by order of the State authorities. A single mongoose that had been exhibited in the National Zoological Park, at Washington, died a few months ago, and at present, so far as known, there is only one mongoose on exhibition in the United States, a male, in the New York Zoological Park.

## GAME BIRDS

Importations of game birds included 37,134 Mexican quail, 11,839 Hungarian partridges, and a few tinamous and waterfowl. During the year more interest was manifested in the importation of partridges, and a larger num-

ber was brought in than in any year since the war. Several shipments were from ports in Germany, but some seem to have originated in Czechoslovakia, which for several years has been the main source of supply. In 1924 the authorities in that country placed an embargo on shipments and for a time no partridges were received in the United States, but the entries have now increased to nearly a third of the maximum prior to the war.

Importations of Hungarian partridges this year were almost equally divided between the East and the West, and most of them were received by eight States, as follows: New York, 870; New Jersey, 425; Pennsylvania, 2,079; Illinois, 254; Minnesota, 1,079; North Dakota, 414; South Dakota, 864; and Colorado, 648.

## EGGS OF GAME BIRDS

During the year 13 permits were issued for the importation of eggs of game birds from foreign countries, 6 less than in the previous year. These eggs were chiefly of pheasants from England and ducks and grouse from Alberta. The largest shipments comprised 1,000 ring-necked pheasant eggs from England, which arrived at New York on May 5; 108 duck eggs from Leduc, Alberta, which were authorized to enter at Portal, N. Dak., on May 15; and 160 duck eggs from Leduc, Alberta, at Eastport, Idaho, on June 5.

## CAGE BIRDS

Cage birds, as usual, formed the principal part of the importations and consisted chiefly of canaries and parrots. The canaries numbered 330,000 and the parrots 53,770. Among the rare species imported were an imperial parrot (*Amazona imperialis*) from Dominica, a cicero (*A. versicolor*) from St. Lucia, and the rare parrot *Dasyptilus pesqueti* from New Guinea, by the New York Zoological Society. The imperial parrot has been imported three times before, but the other two have not previously been seen alive in the United States. Several rare birds from the South Pacific arrived at San Francisco, including a black cockatoo (*Microglossus aterrimus*) and four pigeons (*Gallicolumba helviventris*) from Australia, and two pigeons (*G. stairi*) from the Fiji Islands. Other notable species were 36 tinamous (*Nothoprocta perdicaria*) from Uruguay; 2 hyacinthine macaws (*Anodorhynchus hyacinthinus*), 1 pearly parakeet (*Pyrhura perlata*), 1 hawk



parrot (*Derophtus accipitrinus fuscifrons*), and 1 crested guan (*Penelope jacuacu*) from Brazil; 6 argus pheasants (*Argusianus argus*), 4 greater birds of paradise (*Paradisea apoda*), and 2 king birds of paradise (*Cicinnurus regius*) from Singapore; and 2 copper pheasants (*Phasianus soemmerringii*) and 70 finches (*Stictospiza formosa*) from Japan.

#### IMPORTATION OF QUAIL FROM MEXICO

The season of 1926 proved the third largest for the entry of quail from northeastern Mexico since importations began in 1910. The total number imported was 37,134, of which 10,000 were entered at Eagle Pass, Tex., between February 17 and 26; 1,737 at Laredo between March 10 and April 24; and 25,397 at Brownsville between February 15 and April 24. As was the case last year, shipments were regulated through concessions granted by Mexican authorities, the entry of 10,000 being authorized at Eagle Pass, 10,000 at Laredo, and 50,000 at Brownsville.

Inspectors of the Bureau of Animal Industry examined all shipments at the border, but found no quail disease. Weekly reports were made on the condition of the birds and the details of the shipments, thus furnishing a complete check on the destination of entries. Nearly all were shipped to points south of Pennsylvania and the Ohio River, as follows: Texas, 5,721; Oklahoma, 10,000; Kansas, 4,969; Missouri, 515; Mississippi, 4,980; Alabama, 4,162; Georgia, 922; Kentucky, 3,399; Maryland, 700. Of the Northern States, Illinois received 662, New York 250, and other States 224. An interesting fact in connection with these importations is that three of the principal States—Kansas, Oklahoma, and Texas—that received Mexican quail furnished most of the stock for other regions 20 years ago, and in Oklahoma 1,000 quail were reintroduced at a point from which some of the largest shipments were formerly made.

The number of quail imported from Mexico since shipments began in 1910 now aggregates about 266,000, nearly all of which were bobwhites. A few requests were received this season for entries of quail from other parts of Mexico, but because of the requirement that export permits must be obtained from the Mexican authorities before shipments are made,

comparatively few birds crossed the border.

At the request of some of the game commissioners and other persons interested, the Tariff Commission during the summer of 1925 made an investigation of the cost of capture and shipment of Mexican quail, and as a result the import duty on bobwhites was reduced in October from 50 cents to 25 cents each. The experience of the past season indicates that this reduction had little, if any, appreciable effect in increasing the importations, since the number entered was less than in 1925, when 39,170 birds were entered subject to a duty of 50 cents each.

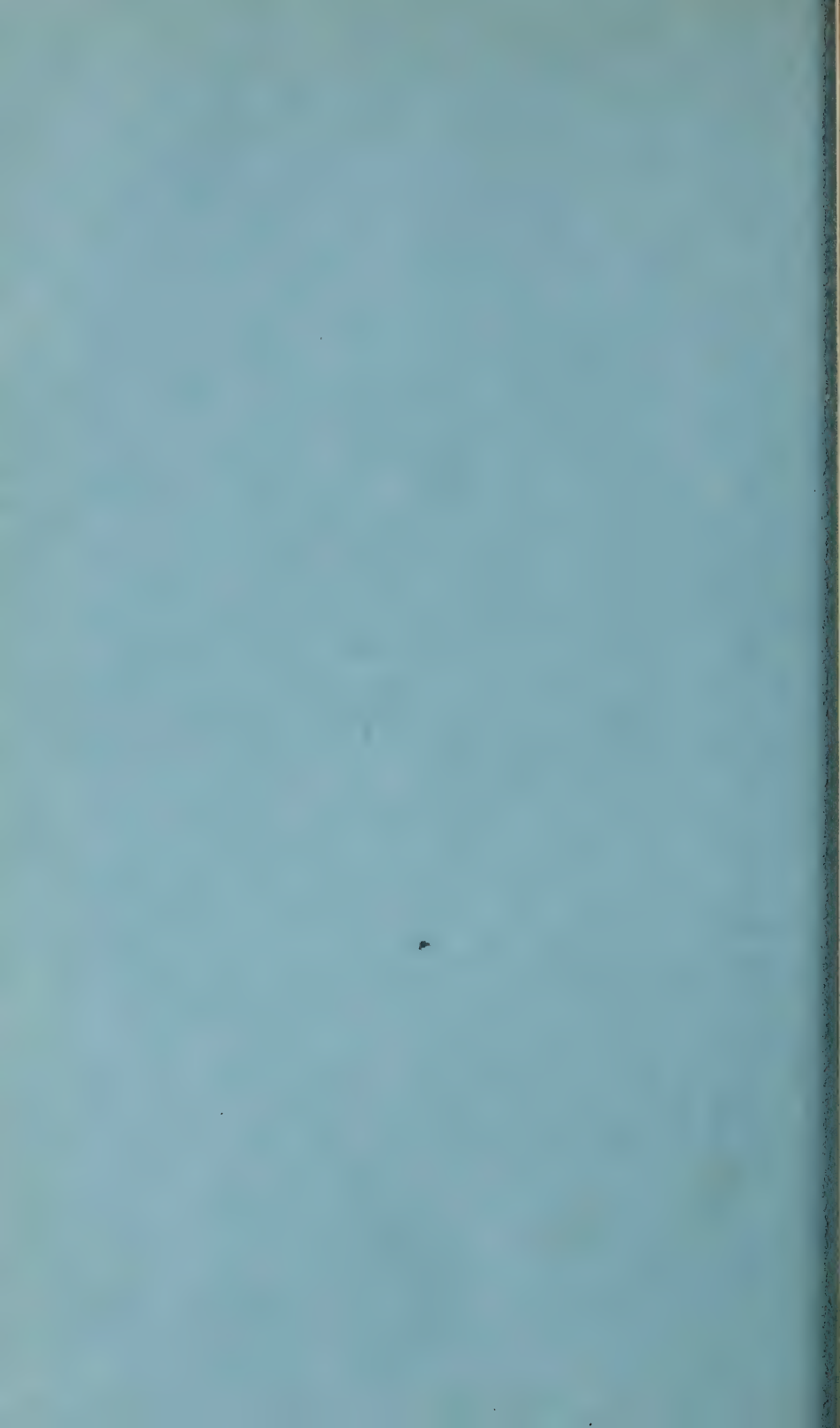
#### EXHIBITION OF BIOLOGICAL SURVEY'S WORK

Concerned as it is with all phases of the conservation, utilization, and control of wild life, the work of the Biological Survey is being well portrayed topically under these three headings in an exhibit at the Sesqui-centennial Exposition at Philadelphia. Conservation of game birds, fur animals, and other interesting, useful, or harmless forms of wild life, in relation to wisely utilizing the natural increase and preventing an undue abundance of forms that are injurious to man, are there depicted. The attention of great numbers of visitors at this exposition is thus drawn to the importance of the wild-life resources of the country from a dual viewpoint: On the one hand, as assets to be enjoyed in natural surroundings or as potential food or clothing; and on the other hand, as liabilities to be eliminated when they are in conflict with man's economy, particularly as they interfere with his production of livestock and of fruit, vegetable, grain, and other crops, or as they destroy the game and fur animals that are useful to him or that he considers more deserving of perpetuation.

Exhibits of like tenor, prepared in cooperation with the Office of Exhibits and the Office of Illustrations have been displayed in various parts of the country, at State fairs, at meetings of sportsmen's and stockmen's associations, and at the annual convention of the National Federation of Women's Clubs, at Atlantic City, N. J., and exhibit material has been used extensively by field representatives of the bureau in stimulating public interest in organizing campaigns for the control of wild-animal pests.







DEC 13 1926

EXPERIMENT STATION FILE

## REPORT OF THE CHIEF OF THE BUREAU OF CHEMISTRY

UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF CHEMISTRY,  
*Washington, D. C., September 1, 1926.*

SIR: I beg to submit herewith the report of the work of the Bureau of Chemistry for the fiscal year ended June 30, 1926.

Respectfully,

C. A. BROWNE, *Chief.*

Hon. W. M. JARDINE,  
*Secretary of Agriculture.*

The Bureau of Chemistry is authorized to investigate problems in the field of agricultural chemistry and to enforce certain regulatory statutes controlling the purity and truthful labeling of foods, drugs, tea, and naval stores.

In the field of agricultural chemistry the work of this bureau is largely concerned with crop chemistry, especially with that part of crop chemistry which includes the study of the composition and utilization of farm products.

### CROP CHEMISTRY

Experimental work conducted during the year has shown that the high-protein wheat resulting from the application of sodium nitrate to the soil at the time of heading yields as much flour as normal wheat raised under the same conditions and that this flour gives a bread having superior qualities. In a field-plot study of the practicability of increasing the protein of wheat by fertilizer applications attention was directed to the quantity of sodium nitrate to be applied to produce the optimum effect, to the possibility of replacing the sodium nitrate by other nitrogenous fertilizers, such as ammonium sulphate, and to the practicability of spacing the rows of wheat so as to permit heading-time applications on a large scale. The best time for applying the fertilizer had been determined in previous years.

Work was done on the possibility of increasing the iron content of green vegetables by applying iron com-

pounds to the soil or by changing the soil reaction, but the results thus far obtained are inconclusive. Some experiments were carried on to determine the effect of soil reaction on the yield and composition of certain crops.

A paper on Soil Reaction in Relation to Horticulture was published to meet the widespread interest in the subject of soil reaction and its effect on plant growth. Such related subjects as the correlation between soil reaction and nitrogen content and the composition of the ash of air plants were studied to obtain information as to the mineral constituents available to plants from atmospheric sources.

### CONSTITUENTS OF THE COTTON PLANT

The results of research work to determine the odorous constituents of the cotton plant have been previously reported. As all those substances were volatile, the investigations already reported were restricted to those products from the plant that could be obtained by distillation with steam. It seemed important, however, to extend the investigation by examining also the nonvolatile constituents of the plant. This work was completed and the results of the investigations were prepared for publication.

### FRUIT AND VEGETABLE UTILIZATION

The demands of the market for more carefully graded fruits and vegetables result each year in larger quantities of culls remaining at the



producing centers. One of the pressing problems of fruit and vegetable growers is to find more profitable outlets for the culls and for the surplus which can not, for one reason or another, be marketed profitably in the fresh state through the regular channels of commerce. The bureau has been working for a number of years on the development of technological processes for manufacturing usable substances from cull and surplus fruits and vegetables to aid in the solution of this problem. The development of such processes not only brings greater returns to the growers but creates new manufacturing industries, which give profitable employment to capital and labor.

The development of new processes for utilizing fruits and vegetables is slow and tedious work, requiring extensive and patient research. The composition of fruits and vegetables as a rule is very complex, and the various chemical substances contained in these products can only be determined by laborious and extended research. After the chemical composition in detail has been determined there remains the experimental work to develop practical processes and devices for manufacturing profitably on a commercial scale the various substances which the researches have shown may be produced. Although progress in both research and development work is often slow, the results are in the long run highly profitable to the growers of fruits and vegetables, as well as to the manufacturing industries. It has been found in this and other countries that the basic research and experimental work must be done by the Government, but that the application of the results may be left to private capital and individual initiative. The returns from the basic research work are often so long delayed that it can not well be financed by individuals, who must ordinarily expect a return upon their investment within a reasonable time.

The report of the chemist for 1925 outlined the steady growth of the commercial application of methods worked out in the bureau for the utilization of cull and surplus oranges and lemons, particularly in California. Several commercial concerns are now manufacturing on a profitable scale numerous marketable products from large quantities of cull oranges and lemons which would otherwise go to waste. The research work begun in the Bureau of Chemistry laboratory at Los Angeles about 12 years ago is now

proving most profitable to the citrus-fruit industries of California.

The basic research work of the Los Angeles laboratory was continued during the year. A chemical study is being made to ascertain the exact composition of orange and lemon oils for the purpose of determining whether the inability to manufacture satisfactory terpeneless oils from the California citrus fruit is due to some fundamental chemical difference between these oils and those made from European oranges and lemons or to variations in the processes of manufacture. The results of this research should show the relative values of the oils for certain uses, such as the manufacture of ice creams, hard candies, cake icings, perfumery, and beverages. By means of an improved machine to press the oil from orange peel and lemon peel developed during the year at least 5 pounds of oil can be extracted from the peels of a ton of lemons. One concern in Los Angeles uses 60 tons of citrus fruit a day in making juice by means of a revolving burr-type machine. As citrus oils are worth approximately \$2.50 a pound, the extraction and utilization of the oil would mean an additional return of \$12.50 for each ton of cull fruit or, on the output of this one plant, a gross additional income of \$750 a day. More work must be done to perfect the machine and the process for extracting the oil before this possible additional return can be realized. It is believed that research work now under way on the detailed chemical composition of the oils from orange and lemon peel will develop information that will enable California manufacturing concerns to utilize these oils for all purposes for which the European product can now be used.

Work was continued on the utilization of pomegranates, the production of which is increasing rapidly in California. Pomegranates must be carefully graded for the market, with the result that large quantities of culls are available. A satisfactory concentrated juice and jelly have been experimentally manufactured in the Los Angeles laboratory. One commercial concern is now producing juice and may shortly take up the manufacture of this product in concentrated form. The development of juice manufacture is retarded by marketing problems. Other concerns are considering the manufacture of concentrated juice and jelly from pomegranates. An improved press devised for extracting pomegranate juice in experimental

work has delivered a very satisfactory yield.

Work was carried on in concentrating pineapple juice. Up to the present time manufacturers have not been able to produce satisfactory concentrated juice from the skins and cores of pineapples, the juice being bitter and dark. In experimental work at the Los Angeles laboratory a light-colored well-flavored sirup has been produced directly from the pineapple juice. Only a limited amount of work has been done on the juice from skins and cores and the concentrate produced up to the present time is only of medium quality, being too dark and not well flavored. Further work will be necessary to develop processes for making an entirely satisfactory article. From work already completed, however, it is thought that the juice from cores and skins might with proper concentration be used as a vehicle for carrying shredded pineapple at soda fountains.

Another important problem now confronting the growers of fruits and vegetables is to know at exactly what stage of maturity the fruit should be picked in order that it may reach the market in the best possible condition. If fruit is picked too early, it never attains its finest flavor. On the other hand, if fruit is not picked until too late it is very likely to begin to deteriorate before it reaches the consumers, resulting in large losses, particularly when it is shipped for long distances. It is not practicable to determine by physical examination alone when the fruit has reached that degree of maturity which is best for picking. Some chemical test is necessary. The Los Angeles laboratory has made a study of the chemical factors that are affected by the degree of maturity in various fruits in order to devise tests by which the growers can determine when the fruit should be picked.

In previous reports the results of work on tests to determine the maturity of cantaloupes and oranges have been outlined. These tests for maturity have been applied commercially to oranges for a number of years and to cantaloupes for two years. The bureau has received many letters from growers stating that the use of these standards has prevented great losses. Work has been completed on maturity standards for raisins and the results await publication. A tentative standard worked out for maturity in the pomegranate has been tested through one crop. It will be necessary to test this standard through at least one

more crop before it can be certainly determined that it is the most satisfactory standard that can be developed. At a recent meeting of growers of pomegranates it was decided to ask the California Legislature at its next session to legalize the standard. In the meantime it will be tested during another season.

Research work was conducted to determine the chemical changes taking place in oranges during freezing in order that methods may be developed for detecting and for separating the frozen oranges. It is highly important, both for the producer and for the consumer, that frozen fruit be eliminated before being shipped to the market. Unfortunately frozen oranges can not be detected by visible inspection. A sure method for sorting out all frozen oranges would be of immense benefit to the fruit-growing industries and also to consumers by reducing the risk they run of getting frosted oranges. If separated out in time at the point of production, the frozen oranges can be used in the manufacture of certain by-products.

Investigations designed to reduce the quantity of sulphur dioxide used in drying fruits were continued.

### COMPOSITION OF VEGETABLE OILS

Studies of the complex chemical composition of vegetable oils were continued in order to develop the more profitable utilization of these oils. A method was found for the quantitative estimation of the mucilaginous impurities of raw linseed oil. Linseed-oil foots can also be determined in the same manner. For years chemists of the paint and varnish industries have been seeking a method for the quantitative determination of these impurities in connection with their studies on the relative quality of different lots of raw linseed oils.

Researches on crude cottonseed oil were continued. The glycerides palmitin and dipalmitin were isolated from crude cottonseed oil and identified. This is the first instance on record where pure glycerides have been separated from cottonseed oil. A knowledge of the character of the glycerides composing this oil has long been desired by the industry. The dipalmitin, which was present in small quantities, was undoubtedly formed from the hydrolysis of a triglyceride. The glucoside phytosteroline was also separated from crude cottonseed oil. It occurs in very small amounts. This is



the first instance where a compound of this class has been observed in a vegetable oil.

The chemical composition of rice oil has been determined. It was found to contain glycerides of myristic, palmitic, stearic, arachidic, lignoceric, oleic, and linolic acids. Rice oil is characterized by the very rapid development of large quantities of free fatty acids owing to the presence of a powerful fat-splitting enzyme. These acids are set free to a notable extent even before the oil is extracted from the bran or polishings.

The keeping-quality experiments on filtered crude oils and on oils kept in contact with foots have been in progress with cottonseed, linseed, and peanut oils. With cottonseed oil the conclusion has been reached that it is preferable to separate the foots as soon as possible after the expression of the oil. This study has shown that it is impossible to predict how crude oil will keep. Oils of the same quality behaved differently upon storage.

#### DETERIORATION OF FORAGE AND FEEDING STUFFS

The "spontaneous" heating of food-stuffs and feeding materials, one of the chief causes of the deterioration of grains, cattle feeds, and breadstuffs of many kinds, is responsible for enormous losses each year. Occasionally such heating becomes excessive and causes destructive fires, which may involve railroad cars loaded with grains or cattle feeds, grain elevators, or barns filled with improperly cured hay.

In seeking to define the cause of such losses, experimental work has been pursued for the past three years. An apparatus has been devised with which it is possible under well-controlled conditions to measure (1) the thermogenic powers of widely different products under various conditions, (2) the thermogenic powers of significant species of bacteria and molds, and (3) the influence of certain physical factors upon the amount and rate of heat production. Oxygen (air) has been shown to be essential to the heating, and when continually supplied it facilitates the production of high temperatures. It has been shown, for example, that corn meal containing more than the critical moisture content for storage will heat under certain conditions to 145° F., resulting in a moldy product that appears to have been badly burned.

Study of pure cultures has shown that many bacteria in their metabolism liberate appreciable quantities of heat. Moistened sterilized cracked corn was used as a medium for bacterial growth. After a period of incubation, during which marked growth and heat production had taken place, the corn showed a definite decrease in carbohydrate, with little loss of protein.

#### NUTRITIONAL INVESTIGATIONS

Work was continued to determine the exact chemical composition and nutritive value of the proteins of various foodstuffs.

Feeding experiments to determine the nutritive value of the proteins of wheat bran have been brought to a close, and the results are published in the third of a series of papers entitled "The Proteins of Wheat Bran." The other articles of this series had stated that the proteins of bran contain high percentages of those amino acids which are essential for the normal nutrition of animals. Therefore it seemed probable that bran would furnish proteins of a satisfactory nutritive character. The feeding experiments have substantiated that view. Young animals receiving no other protein than that furnished by commercial wheat bran have grown at a rate better than normal. On the other hand, after reaching maturity they did not do so well relatively. It appears that the bran contains some factor which meets the nutritive requirements of the young growing animal but is deficient in some other factor necessary for the satisfactory nutrition of the adult.

The work on the nutritive value of certain types of sea foods has been confined chiefly to oysters and clams. Both the nutritive character of their proteins and their vitamin content have been studied. The work is still in progress. The results thus far obtained show that oysters are a good source of vitamins A and B. Clams do not appear to be a good source of vitamins. On the other hand, the proteins of the clam have given better results than those of the oyster. The proteins of shrimp have also been studied, both chemically and by feeding experiments. The amino acid content of this muscle has been determined and the results published. Shrimp muscle does not seem to vary much from the muscle of other animals. Feeding experiments have



shown that the proteins of shrimp muscle are of a good nutritive character.

A study was made of the proteins of timothy and orchard grass pollen and their relation to hay fever. The causation of hay fever is generally attributed to the proteins of pollen carried by the air during the pollination season. A thorough study of the individual protein or proteins responsible for hay fever had not been made before. If protein is the cause of hay fever, then by isolating the different proteins of pollen it might be possible to determine directly which one is responsible for the disease. The isolation of the proteins of timothy and orchard-grass pollen was therefore undertaken. Three fractions of each protein were prepared. With the cooperative assistance of an authority on hay fever, it has been found, by means of so-called skin-reaction tests, that the substances of the proteose fraction of the pollen are the exciting cause in all hay-fever patients sensitive to timothy pollen, and that the albumin fraction is an added toxic factor in about 50 per cent of the subjects. The importance of the glutelin fraction is negligible. A patent based on the results of this work has been granted. It relates to the preparation of specific solutions containing one or both of the active fractions in pollen obtained from plants substantially free from other extractives. This permits accurate dosage and prevents the introduction into the human system of nonspecific substances.

The determination of the dicarboxylic amino acids, aspartic and glutamic acids, is being carried out in a number of typical well-known proteins. Materially larger quantities of these acids have been found in several proteins than have been previously reported.

Work was undertaken during the year to determine the vitamin potency of various foods and drugs in order to develop information for the guidance of officials in the enforcement of the Federal food and drugs act. Several well-known brands of cod-liver oil are being tested for their antirachitic properties.

#### LEATHER, PAPER, AND FABRICS

Special attention has been given to the conservation of hides and skins in order that more leather and eventually longer-lasting shoes and other leather articles may be made. An interdepartmental committee on hides and

skins has been formed by the Secretary of Agriculture and the Secretary of Commerce to plan, in cooperation with representatives of agricultural interests and of hide and leather industries, a broad program of work by the Department of Agriculture for the conservation of hides and skins. At a conference attended by the Secretary of Agriculture, the Secretary of Commerce, and representatives of the various interests concerned all phases of the problem of hide conservation, including damage by grubs and other insects, diseases, brands, and other physical defects, processes of skinning, curing, classifying, and marketing, and the collection of statistics were presented and discussed. It was the consensus of opinion of those at the conference that the first efforts should be concentrated upon grub eradication, because it promises the greatest benefit, both to agricultural interests and to users of hides and skins.

The damage to hides and leather resulting from follicular mange was studied with a view to prevention. So far no practical results have been obtained.

Further work has been done on the tannin content of chestnut stumps and roots, and other possible new sources of tannin have been investigated.

The study of the deterioration of leather has shown that corrosion by polluted atmosphere is one of the causes of the rapid decay of leather bindings and other leather articles. Means of reducing this serious damage have been indicated. The results of this work, which have been published, show that leather in the different sections of a deteriorated binding exhibits marked difference in physical condition and chemical composition. That part of the binding most exposed to air and light is the most deteriorated, has the highest acidity and sulphate content, and shows the greatest modification of leather into water-soluble nitrogen compounds. Light, although already proved to be harmful to leather, can not alone account for such an increase in the sulphur or sulphate content of the binding. The indications are that part of the deterioration is caused by the accumulation within the leather, in destructive quantities, of harmful sulphurous and acidic impurities from the usually polluted atmosphere, particularly that of large cities and industrial centers where most important libraries are located. Proper finishing of the leather in the making and proper oiling from time to

time while it is in use are the chief remedial measures.

Work has been continued on roach damage to book cloths, with confirmation of the earlier findings that the practical solution of the problem lies in the elimination of foodstuffs from the loaded cloth or in the application of a suitable repellent finish to the cloth.

Defective shoes are being studied to determine causes of failure and means to prevent recurrence. A study is being made of the ripping of thread in shoe soles. This work is being done with the idea that the acidity of the bottom leathers may be correlated with the ripping or breaking of the thread. Sometimes the results suggest that acid in the leather is the cause of loss of strength and consequent breaking of the thread with which the leather is sewed; at other times they do not. A number of preliminary laboratory experiments are being made to determine what factors other than acids might be involved, as, for example, different tanning materials.

Experiments were started during the year to ascertain the effect of syntans upon leather. The strength of the leather will be determined at the end of different periods of aging. Experiments started several years ago to show the effect of sulphuric and other acids upon the strength of leather are still in progress.

A detailed study has been made of the application to miscellaneous tannery materials of the toluol distillation method for the determination of moisture, particularly in materials like oils, greases, soaps, emulsions, and sirups, which can not be handled readily by a direct-flame or oven-drying method. The results have been prepared for publication.

Physical tests were completed on a large number of fruit and vegetable wrapping papers collected in various parts of the country from paper manufacturers and dealers and from fruit and vegetable packers and shippers. Many of these wrappers were known to lack enough flexibility and strength to withstand the vigorous rapid twist given the paper under service conditions. The data collected showed that paper for wrapping apples, citrus fruits, pears, tomatoes, etc., should weigh 10 to 12 pounds per ream of 500 sheets, 24 by 36 inches, and should have a bursting strength of not less than 6 points. This information has been of direct service to the growers and packers of citrus fruits.

Because of its importance in the quality and conservation of paper, an investigation was started to determine the moisture content of various kinds of paper at different humidity conditions. The results so far obtained indicate a rather wide variation in the moisture content of paper exposed to a definite relative humidity and temperature. The results also indicate that there may be more than one possible value for the moisture content of paper for a given definite relative humidity and temperature, depending upon the previous atmospheric conditions to which the paper was exposed.

The work on the development of processes for waterproofing, mildew-proofing, and fireproofing fabrics for farm and other uses was continued.

Observations on samples of treated canvas that had been exposed under conditions favorable to mold and bacterial decay showed that many of the pigments used in connection with waterproofing treatments for the purpose of decreasing damage by sunlight also have a marked preservative effect against mildew and rot. The work on tobacco shade cloth showed definitely that treatments devised by the bureau will at least double, if not triple, the life of this cloth. These results, if properly used by tobacco growers, will save them from one to two million dollars annually.

## NAVAL STORES

A study was made of the by-product turpentine obtained by condensing the vapors arising from digesters in which resinous wood is cooked to produce paper pulp by the sulphate process. A number of samples of this type of turpentine from various domestic manufacturers and from importations have been examined in the laboratory in order to obtain as much knowledge of the properties, characteristics, constituents, and constants as possible.

Methods for determining the so-called melting point of rosin and for determining the percentage of dirt or foreign matter other than rosin were studied in collaboration with the committee on naval stores of the American Society for Testing Materials. Analytical work in collaboration with the Association of Official Agricultural Chemists to develop methods of analysis was continued.

Statistics on the consumption of turpentine and rosin by consuming indus-



tries during the 12 months ending March 31, 1925, and on stocks held at primary ports, distributing centers, and consumers' plants on March 31, 1925, the close of the 1924-25 producing season, were compiled and published.

Assistance was rendered to a number of independent producers of rosin who were having trouble in getting their rosin correctly graded. Samples which were used for grading were sent to the laboratory for check grading, and the results were transmitted to the manufacturers.

Work on the preparation of definite type samples for naval stores was continued. The glass standards for rosin, which under the naval stores act were made the official rosin standards of the United States, were greatly improved and made more serviceable for the regular grading of rosin. Ten sets of improved glass standards for rosin were completed during the year. Work was started on the assembly of 10 additional sets, but these were not completed at the end of the year. One of the sets was deposited with the United States consul at Bordeaux, France, for the use of the French trade and as a guide to the Pine Institute of France in its recently adopted program of preparing official standards for rosin for the French naval-stores industry.

In conformity with a ruling of the Florida secretary of state all rosin inspected in Florida must be graded according to the United States official standards, and all inspectors in Florida have been supplied with sets of these standards for use in grading rosin. The Florida naval stores law was amended to conform to the Federal naval stores act. A tentative scheme for grading wood rosin has been worked out and new types have been prepared and submitted to the trade.

Work was continued in demonstrating to the industry improved processes for producing naval stores. An experimental gum-cleaning plant, designed to clean the gum before it is distilled, has been operated in southern Georgia during the season.

Interesting and important data on the properties of American turpentine gum and on the difficulties to be encountered in cleaning, handling, and distilling it by improved methods have been obtained as the result of the experimental work done so far. From the information obtained it has been possible for the representatives of the bureau who have worked on this

project to give valuable assistance to private concerns working on similar lines to improve the processes of making and handling naval stores.

## SIRUP AND SUGAR INVESTIGATIONS

In response to the urgent demand, a procedure for making maple cream of improved quality was worked out and circulars describing it were distributed throughout the maple-producing sections. This method makes possible the production of maple cream of desirable consistency. It reduces the danger of fermentation and retards the separation of sirup from the cream on standing. As maple cream affords an important market outlet for the sale of maple products, this method has great economic possibilities.

Progress was made in the work on a method for producing unsulphured cane sirup of good quality from low-purity cane juice. This procedure will permit heavy milling and greater extraction of juice in the manufacture of this type of cane sirup and reduce the loss resulting from low juice extraction. When used in conjunction with sugar production it will be possible to use the higher-purity juice for sugar, the lower-purity juice, representing higher extraction, being used for making sirup. This will make for greater economy in the commercial utilization of sugar cane under domestic conditions. As a part of this investigation a method for producing a new article called "cane cream" has been devised. The production of cane cream on a semifactory scale will be undertaken during the season of 1926. Cane cream, which is also made from the lower-purity juice, has a consistency similar to that of confectionery fondant and a characteristic cane flavor. It can be made of widely varying consistency, and can be used for many purposes, for instance, in sandwiches, on griddle cakes, and in the preparation of cake icing. The cost of manufacture is moderate, and the use of lower-purity juices for producing cane sirup and cane cream will make possible greater efficiency and economy in the manufacture of sugar from higher-purity juices when used in conjunction with it. The fabrication of these products is part of a general plan for the production of specialties which is believed to be of great economic importance to the Louisiana sugar industry.

Progress was made in an investigation of the fundamental conditions



governing the clarification of cane juice in the production of raw and plantation granulated sugar. Because of the lack of a full understanding of the various factors which control clarification of juice, the elimination of nonsugar substances from juice in sugar manufacture is conducted with a varying degree of efficiency, and the maximum clarification possible is far from being consistently attained. It is known that the exact combination of conditions required for maximum clarification varies greatly from one kind of cane juice to another, depending on such factors as variety of cane, soil, kind of fertilizer used, degree of maturity of cane, whether the cane has been burned or not, and length of time the cane has been cut. Methods are being devised whereby the juice can be tested from time to time and suitable adjustment made in clarification conditions so as to obtain uniformly the maximum efficiency possible with the clarification process used. This work is being conducted in conjunction with the development of means for controlling the addition of lime to cane juice automatically by means of a potentiometer, which also continuously records the pH values. The pH value maintained by the potentiometer control can be readily changed from time to time, as the condition and type of the juice may demand.

A method of selective fermentation has been devised whereby the invert sugar of cane molasses may be transformed into alcohol without fermenting sucrose. This makes possible the application of methods for the desugarization of cane blackstrap molasses and at the same time affords a profitable utilization of the invert sugar present, which would otherwise not only be wasted but would also interfere with the recovery of sucrose. A public-service patent covering this process has been issued.

Information of much value has been obtained in an investigation of the fundamental conditions governing the action of decolorizing carbons, including bone char, in removing colloidal substances present originally in cane and beet juices and also produced as a result of decomposition reactions during the course of sugar manufacture. This investigation, which is being continued, throws much light on the particular types of colloidal substances that are best removed by decolorizing carbons and those that could be eliminated most profitably at an earlier stage in the clarification of the juice.

Tests have been devised which show the types and quantities of colloidal substances present at each stage in the sugar process, so that exact control can be exercised. The data obtained also suggest means for the more efficient use of decolorizing carbons.

A method has been worked out whereby the clarification of acid digestion liquors in the manufacture of glucose and corn sugar may be greatly improved. This is of much importance in view of the fact that uneliminated colloidal substances interfere with the growth of corn-sugar crystals. If the crystals are too small, difficulty is experienced in separating them from the mother liquor by centrifuging. High elimination of colloidal substances is desirable both from this standpoint and from the standpoint of producing corn sirup of greater clarity. This improvement is of distinct benefit to the rapidly growing corn-sugar industry, which in 1925 produced almost 600,000,000 pounds.

A systematic investigation has been made of the carbohydrate constituents of a number of plants about which insufficient information was available. This work is designed to yield fundamental information on the basis of which new uses may be found for plants now cultivated or capable of cultivation and by-products of existing processes of utilization may be used more profitably.

An investigation of the variation in viscosity of beet molasses in relation to its retarding effect on the crystallization of low-purity massecuites was practically completed. Viscosity measurements were made after adjusting the molasses samples to constant sucrose-water ratio, constant sucrose-raffinose-water ratio, etc., and the influence of different constituents and groups of constituents on the viscosity of molasses was indirectly determined. The data were also examined from the standpoint of their relation to the discarding of molasses in the Steffen process for desugarizing beet molasses.

In cooperation with 25 beet-sugar factories, an improved method for determining sucrose and raffinose in beet products which had been worked out by the bureau was tested with satisfactory results. This method makes possible closer chemical control of the recovery of sucrose, thereby assisting in locating and ultimately reducing sucrose losses.

An extensive investigation was made in the field on the relation between the composition of sugar beets and the

recovery of sucrose from them, particular attention being given to the efficiency of elimination of colloidal nonsugar substances at various hydrogen-ion concentrations and at various stages of the process.

Work was started for the purpose of determining the character of substances present in various grades of cane and beet sugar which give rise to objectionable color in a number of commercial products, including confectionery, made from them. The ultimate purpose is to devise suitable means whereby these substances may be eliminated.

A number of publications giving the results of completed investigations were issued during the year.

### INSECTICIDE AND FUNGICIDE INVESTIGATIONS

The Bureau of Chemistry under a specific appropriation investigates and develops methods of manufacturing insecticides and fungicides and studies chemical problems relating to their composition, action, and application. The need for more effective and cheaper insecticides and fungicides to check the enormous losses caused by the depredation of insects and by fungus growths has long been apparent. The chemical work of the bureau is done in cooperation with the Bureau of Plant Industry, which is concerned with the control of fungous diseases, and with the Bureau of Entomology, which is concerned with the control of insect pests.

#### OIL EMULSIONS

The use of lubricating-oil emulsions and miscible oils for the control of San Jose scale, citrus white fly, and citrus scale insects has increased greatly in recent years. The formula now most generally employed for making lubricating-oil emulsions requires heat or a large proportion of soap. In the preparation of boiled emulsion the use of heat is both time consuming and expensive, and the use of the cold-emulsion formula, calling for an increased proportion of soap, greatly increases the cost of the product. As the result of a cooperative study of this problem, the Bureaus of Chemistry and Entomology have developed a modification of the method of making cold-mixed emulsions which gives a product that is apparently as stable and as effective as the best boiled emulsions and can readily be made by the orchardist. The proportion of soap

is the same as or smaller than that used in the present formula for boiled emulsions, so that the cost of the product is materially decreased. This emulsion may be made and shipped in the form of a paste, containing only 8 per cent of water, thus reducing the packing and shipping charges below those necessary for ordinary concentrated emulsion. Using the new formula, one grower made several thousand gallons of emulsion, which was used against the San Jose scale with satisfactory results.

There was also developed a soap-cresol-oil emulsion which contains less cresol, the most expensive ingredient, than the ordinary miscible oil, and is therefore less expensive. When diluted for spraying it has the small-drop size and stability in hard water characteristic of miscible oils, and spraying experiments made by the Bureau of Entomology indicate that it is as toxic to insects as a product made by the old formula.

#### CHEMOTROPIC WORK WITH FLIES

Work was continued during the year to obtain satisfactory attractants and repellents for flies which infest animals and insecticides for flies at the various stages of their development. Experiments with repellents for the screw-worm fly and other meat-breeding flies carried on in collaboration with the Bureau of Entomology have produced valuable information regarding the chemical responses of these insects and the development of control measures. The screw-worm fly alone is estimated to cause a loss of \$4,000,000 annually among animals in the Southwestern States. The repellent or attractant action of several hundred compounds and mixtures were tested in the proximity of packing houses and other places where flies are abundant. Of the organic chemicals tested which show the greatest repellent action against the screw-worm fly, using treated beef liver as bait, four were naphthalene derivatives and seven were tear gases. Field tests with repellents on domestic animals have shown that pine-tar oil, which is obtained by the destructive distillation of stumps and dead wood of the long-leaf pine, is effective and is at the present prices the most economical to use. Pine-tar oil does not injure animals upon which it is applied and has met with the favor of ranchmen, who are now using it on a large scale.



### FOLIAGE INJURY BY CALCIUM ARSENATE AND OTHER INSECTICIDES

To determine why some commercial calcium arsenates are more injurious to cotton foliage than others, a study was made of the effect of such conditions as temperature, concentration, and time of stirring on the chemical nature of calcium arsenate made from hydrated lime and arsenic acid. No definite conclusions have been reached. An investigation of colloidal arsenical insecticides is being conducted. Colloidal insecticides may be of importance because of their greater subdivision, which gives them higher covering power and makes them more easily ingested by insects. It has been found that gum arabic, gelatine, and other protective colloids strongly repress the rate of solubility of white arsenic, which may permit its use as such on some foliage. A paper describing this work is ready for publication. True colloidal calcium arsenate has been prepared and the conditions under which it can be formed have been studied in detail.

### CHEMICAL COMPOSITION OF PLANTS HAVING INSECTICIDAL ACTION

Work was carried on to find substitutes for insect flowers and to determine whether compounds corresponding to the active constituents of plants can be made synthetically in such a way that they will have insecticidal action. The oil and alkaloid of staves-acre seed have been isolated and the pure oil in quantity is now available for entomological tests. Obtaining the alkaloid in pure form presented many difficulties. Delphinine was the only alkaloid obtained. Early investigators reported as many as four alkaloids, but the existence of this number is extremely doubtful, as most recent investigators have found only the one. The results of the work are now ready for publication.

The investigation of pyridine derivatives during 1925 showed that the dipyrityls would not account for the unusual toxicity of the "dipyrityl" insecticide. The year's work covered by this report has shown that this "dipyrityl" insecticide contains an extremely toxic body, probably a partially reduced dipyrityl, which from its resemblance to nicotine in toxicity has been designated "neo-nicotine." Unsuccessful attempts were made to oxidize it to dipyrityl. Work is being continued to complete its final identification.

A large number of substituted pyrrol, pyrrolin, and pyrrolidin compounds have been prepared and tested on insects, on the theory that the pyrrolidin nucleus of the nicotine molecule is the carrier of toxicity. Although most of these compounds showed marked insecticidal properties, none of them proved to be as effective as nicotine. Moreover, there were no significant differences in the effects of the various derivatives. On the other hand, several compounds prepared from nicotine containing the pyridin ring, but having groups, generally straight chains, substituted for the pyrrolidin, proved to be of about the same order of toxicity as nicotine. As far as the evidence goes, it seems that the pyrrolidin group in nicotine is not essential, and purely synthetic compounds may be prepared with simpler groups substituted for it. This theory is now being tested.

Department Bulletin 824, Insect Powder, issued in 1920, was revised and brought up to date. The most recent results by the Bureau of Chemistry and other investigators on the active principles of pyrethrum are now included in it.

### PREPARATION OF INSECTICIDES AND FUNGICIDES

Work was continued on the project to determine cheap and effective methods of preparing insecticides and fungicides and to study their properties. In the search for substitutes for carbon disulphide in grain fumigation about 85 organic compounds have been carefully tested to determine their insecticidal action upon the rice weevil. Several of these compounds were found to be from 5 to 10 times as toxic to rice weevils as ethyl acetate. In combination with carbon tetrachloride they show promise of proving economical, practical, noninflammable, and free from the objections of the grain trade to the residual odor of the ethyl acetate-carbon tetrachloride mixture. The results of this experimental work will be published as soon as some large-scale experiments in box cars loaded with grain have been completed. These tests will be made later in the year when weevil-infested grain in sufficient quantity is available.

Studies were continued on copper compounds for grain smut control. In work on basic cupric sulphates, 20 or 25 products were prepared under different conditions of temperature, ratios of reactants, and concentrations, with the view of determining



the effects of these varying factors on the finished products. The results have been prepared for publication.

In working with the cupric carbonates a number of products were prepared both for study in the laboratory and for field testing. As it has been found that basic copper carbonate is very effective in the control of a fungous disease of sugar beets, a dozen products were prepared and turned over to the office of sugar-plant investigations of the Bureau of Plant Industry. The results of these tests were encouraging in that one or two of the preparations were very effective in the control of this disease. A large sample has been prepared and sent to a commercial firm for further field tests. Results of these tests have not yet been received.

Work on calcium, barium, and sodium sulphur sprays has been completed and the results published in Department Bulletin 1371, entitled "Effectiveness Against San Jose Scale of the Dry Substitutes for Liquid Lime-Sulphur."

An investigation on the deterioration of bleaching powder in storage was completed and the results published in Department Bulletin 1389, "Deterioration of Commercially Packed Chlorinated Lime."

### PLANT-DUST EXPLOSIONS AND FIRES

Research investigations by the bureau have indicated that practically all types of combustible dusts when mixed with air in proper proportions may, when ignited by various external sources, produce disastrous explosions. Approximately 28,000 industrial plants in the United States, employing 1,324,422 people and manufacturing products worth more than \$10,000,000,000 annually, are subject to dust-explosion hazards. Dust explosions result often in the loss of many lives and great property destruction.

The bureau has endeavored to determine the causes of these explosions and to develop methods of control and prevention. Recent experimental work includes the determination of ignition temperatures of dusts of various types, the pressures produced upon ignition, the limits of concentration, and other essential data related to the degree of relative flammability of the dusts. Incidental to the research work, various dusts submitted by manufacturers have been tested for explosibility. In addition to relative flammability and ignition temperatures, the tests included the determination of the par-

ticle size and sometimes moisture and ash. When sufficient information was received from the manufacturer concerning the nature of the operation producing the dust, suggestions were made as to how the dust-explosion hazard might be reduced or eliminated. Reports on numerous dust explosions and fires were received during the year. Investigations were made wherever practicable to ascertain the exact causes of the explosions and resultant fires.

Department Bulletin 1373, entitled "Dust Control in Grain Elevators," was published and distributed to grain elevator operators and milling companies interested in dust control. This bulletin covers the results of a survey of a number of elevators on the Atlantic seaboard and in the Middle West, and deals with the development of dust-control systems which will operate efficiently in terminal grain elevators to reduce the dust-explosion hazard. Much interest was manifested in the recommendations made in the bulletin concerning a satisfactory method of dust collection in grain elevators.

### METHODS FOR CONTROL OF STATIC ELECTRICITY

Experimental work to develop suitable compositions for the elimination of static electricity on several types of belts was continued, previous work having shown that static electricity generated by the friction of belts is one of the common causes of the ignition of explosible dusts. Arrangements have been made for conducting large-scale tests under operating conditions. Experiments have shown that a leather belt requires a composition of a type entirely different from that required by a rubber belt. A great many compositions were made for rubber belts that were satisfactory for the elimination of static electricity. The material that seemed to be the best was applied to belts in the machine shop of the department. The composition removed the static and was found to wear exceptionally well. This composition was also tried on the belts in the shops of a railroad company preliminary to testing it on the belts of a large grain elevator.

The desirability of having a composition which can not possibly introduce an additional fire hazard led to an investigation to find suitable solvents by the use of which a nonflammable composition could be produced. This required the use of mixed sol-

vents. Several were tried. Finally a mixture of carbon tetrachloride and mineral spirits, consisting of at least 50 per cent carbon tetrachloride, was found to be satisfactory. This dressing is nonflammable, removes static, should increase the life of the belt, and increases the coefficient of static and moving friction. Sixteen gallons of this material were applied to two rubber conveyor belts and to one fabric stitched power-transmission belt in a grain elevator. The small transmission belt was heavily charged with static, the voltage being well over 10,000 volts. By simply coating the exterior of the belt and not even waiting for the material to dry every trace of static on the belt was eliminated. The conveyor belts before coating held from 5,000 to 6,000 volts of static. The belt, which was coated on both sides, was made entirely free of static. The material on the belt was permitted to dry for 36 hours before the belt was used. A hard, dry, elastic coating was obtained and in the preliminary tests there were indications that it would wear for a long time.

The coating material was also tested on threshing machines at a factory in Wisconsin. The belts on four threshing machines were coated with the new preparation. Two of the machines were of the regular stationary threshing-machine type and two of the combine type. All belts coated held charges well over 10,000 volts, the maximum reading which could be obtained by the electrometer used to measure the difference of electrical potential. In every case the preparation seemed to remove all traces of static. The composition for rubber belts was found to be very satisfactory on impregnated fabric stitched belts, which are commonly used as main drive belts on threshing machines.

It is proposed to try out these belt dressings further in experimental work during threshing operations in the Pacific Northwest. Tests were conducted with various types of belts at plants of commercial firms in Minneapolis. The material gave excellent results on the rubber belts and removed the static on leather belts. It is not considered advisable at this time to recommend the composition for use on leather belts. The results of the tests show the desirability of having an entirely distinct type of dressing for leather belts, a dressing that will keep the belt soft and pliable, remove static, cause no deterioration of the belt, and increase its coefficient of friction. Several compositions hav-

ing these qualifications have been made, but have not as yet been tested on a large scale.

### INERT GAS

Experiments were carried on at the Arlington Experimental Farm to determine the best methods of introducing inert gas into grain-grinding machines, where dust is necessarily generated and where friction is likely at any time to cause a spark that may produce an explosion. A small building, with an apparatus for testing the gas obtained from boilers, has been completed. Tests have been run to determine the quality of gas obtained from the boilers and the quantity necessary to maintain an inert atmosphere within the grain-grinding machines. It has been demonstrated by these experiments that when the gas from the boilers is applied in sufficient quantities the dust generated by the grinding machinery will not explode, even when sparks which would ordinarily produce explosions are applied regularly. Demonstrations of this method of controlling explosions were given during the year to representatives of a number of industries interested in dust-explosion prevention. Two large industrial companies have undertaken the installation of inert gas units on the recommendation of the engineers of the bureau.

### LABORATORY TESTS

Experimental work has been done in developing an apparatus by which ignition temperatures can be checked within plus or minus 1° or 2°. This could not be done by methods previously used. A method has been developed by which the ignition temperature of solid combustibles can be checked within a reasonable degree of accuracy. With some refinements it may even be possible to approach more nearly the true ignition temperature. By this method the ignition temperatures of 24 dusts have been determined. As soon as limitations of time and personnel permit other dusts will be tested. Work was also done to determine the effect of prolonged heating on the ignition temperature of several dusts.

### CONFERENCE AND COMMITTEE WORK

Cooperative relations were maintained with the dust-explosion hazards committee of the National Fire Protection Association. This committee, under the direction of the Bureau of



Chemistry, has prepared regulations for dust-explosion prevention in flour and feed mills, sugar-pulverizing systems, cocoa-pulverizing systems, pulverized-fuel installations, terminal grain elevators, and starch factories. These regulations have been adopted by the National Fire Protection Association and also by the National Board of Fire Underwriters and have become the standards for insurance and State officials. The American engineering standards committee has acted favorably upon the dust-explosion codes recommended by the bureau. These codes have been accepted as tentative American standards. It is believed that the adoption of these safety codes for dust-explosion prevention in American industries will result eventually in their becoming international standards.

Specialists engaged in dust-explosion work have held conferences with leaders of various industries who were interested in applying the methods and principles developed for dust-explosion prevention.

In cooperation with the National Fire Protection Association a committee on farm fire protection has been organized. The annual fire losses in the United States have been estimated at approximately \$570,000,000. Of this amount at least \$150,000,000 represents a loss from farm fires. It is recommended that work be taken up to assist in the development of control measures for the reduction of these extensive losses. The committee on farm fire protection includes representatives of the United States Department of Agriculture, American Society of Agricultural Engineers, American Farm Bureau Federation, Mortgage Bankers Association of America, American Agricultural Editors Association, the Farm Association, National Board of Fire Underwriters, Underwriters' Laboratories, Lightning Rod Manufacturers Association, Mutual Fire Insurance Association, Fire Equipment Manufacturers Institute, Association of Canadian Fire Marshals, National Association of Mutual Insurance Companies, and the Fire Marshals Association of North America. It has perfected plans to obtain statistical data on fire losses on farms, preparation of material for educational purposes, and recommendations for fire-prevention and fire-protection methods. The bureau is also cooperating with the national fire waste council of the Chamber of Commerce of the United States, which is now giving

attention to the matter of farm fire protection.

### COLOR, MEDICINAL, AND TECHNICAL INVESTIGATIONS

The bureau is authorized to investigate and experiment in the utilization, for coloring, medicinal, and technical purposes, of raw materials grown or produced in the United States. Much experimental work has been done with a view of developing processes for the manufacture of dyes. Previous reports have indicated the manner in which the bureau has been a contributing factor in the rapid development of the American dye industry. Large quantities of fast dyes are now being made in the United States, which is rapidly becoming independent of any foreign country in the manufacture of coloring materials. Many of the substances developed in the utilization of coal-tar products are useful not only as dyes but also as medicines and in the technical arts.

Ortho-dichlor-benzol is an isomer, produced, along with para-dichlor-benzol, in the chlorination of benzol. Until recently both by-products have found little use in industry. Lately, however, the development of the para compound as an insecticide has increased the demand for it, although no extended use has been found for the ortho derivative. As the latter is formed in the ratio of about 1 part to 2 of the para compound, the growth in the demand for para-dichlor-benzol has made the problem a serious one. Work done under this project has shown that ortho-dichlor-benzol can be combined with phthalic anhydride through the Friedel and Craft's synthesis to produce 2, 3-dichlor-anthraquinone. Upon fusion with caustic, his product is converted into alizarine, one of the most important synthetic dyes. It is hoped that additional uses for dichlor-anthraquinone may be found as an intermediate for vat dyes. The results of this investigation should prove most valuable to the manufacturers of chlorine products. Dye manufacturers have evinced great interest in the results of this investigation.

### MEDICINAL PREPARATIONS AND BIOLOGICAL STAINS

The work in the general field of biological stains and dyes of therapeutic application has been extended. A large number of new dyes, or dyes which at least have never been made available to microscopists, have been



synthesized and tested. These include a variety of halogenated fluoresceins, alkylated thionins, and acid fuchsin. The most important specific accomplishment in this connection has been the isolation of azure C, monoethyl thionin, by means of the acid oxidation of methylene blue. This new product has proved to be a very valuable nuclear and bacterial stain in tissue and of great utility in blood staining.

Several of the more important staining technics of the biologist have been investigated in a preliminary manner and some little improvement obtained by various modifications which the studies have suggested.

It has become increasingly evident in the course of the study of the staining properties of dyes that these properties are often closely connected with bacteriocidal or bacteriostatic properties, which render the dyes potential therapeutic agents of great promise. The outstanding development in this connection has been the discovery that basic dyes react with cyclic derivatives containing phenolic groups to form additive products, which not only are very valuable bacterial stains but also give every promise of utility as practical germicidal agents for the treatment of external wounds. It is even anticipated that certain of these complexes may find effective internal application against malignant organisms.

The routine examination of biological stains and dyes for therapeutic application in order to determine the identity and relative proportions of their components has been conducted, together with extended research in analytical methods for the purpose.

#### UTILIZATION OF FARM PRODUCTS IN INDUSTRY

Work was inaugurated to bring about a closer connection between agriculture and industry. This is not directed so much to the industries ordinarily dependent upon agriculture, such as clothing and food, but rather to those industries whose relations to agriculture are not so widely realized. This includes the further utilization of by-products, such as lignin or furfural, and also a broadening of the use of regular farm products as well as waste materials.

Any additional outlets for corn, one of the leading crops, that may be created by the development of new industrial uses will be of direct benefit to growers. A study has been undertaken of the breaking down of glucose, one of the products from corn, with

various fermentative organisms, such as bacteria, yeasts, or molds, and the consequent development of these fermentation products. It is believed that there is a large opening for the production of either the organic acids which are now in use or some that may be substituted for similar products in industrial applications. This is mentioned as but one example of what it is hoped to do in the matter of providing additional industrial outlets for corn.

Mention has been made in previous reports of the discovery of solvents for lignin and the possibility of using it as a varnish. Lignin, for which no profitable use has yet been found, constitutes approximately 25 per cent of all cell tissues and the supply is practically unlimited. It is even more complex than coal tar, and when it has been as thoroughly studied as has coal tar, it may have even wider uses.

Some preliminary work has been done looking to the utilization of peanut hulls. Up to the present time the uses of peanut hulls have been entirely physical. They are not being used as raw materials in any chemical process. The hulls are brought from the shelling plant and ground to various sizes in an attrition mill. The ground hulls have been used for polishing tin plate, as a substitute for middlings in removing the palm oil after tinning, as a dynamite filler, as a fertilizer filler, and, when mixed with molasses, as a cattle food. The amount of peanut hulls available at the present time is approximately 25,000 tons a year. This is a conservative figure and will undoubtedly increase with more extended uses for the material and with larger consumption of peanuts. Plans have been made to start an investigation by a complete analysis of the peanut hulls in order to determine the actual composition of the material.

#### EXAMINATION OF COMMERCIAL FOOD COLORS

In the enforcement of the Federal food and drugs act commercial food colors are analyzed to determine their suitability for use in food products. During the last year there were certified 311,434.5 pounds of straight dyes under foundation certificates, 32,234 pounds of repacked straight dyes, and 304,040.22 pounds of mixtures. Thirty-eight firms certified food colors, 14 of which were new certifiers. Six batches of straight dye, two repacks, and 33 mixtures were rejected. Miscellaneous

Circular No. 52, Certification of Coal-Tar Food Dyes, a codification and revision of existing certification regulations, and Department Bulletin 1390, Chemistry and Analysis of the Permitted Coal-Tar Food Dyes, which describes the chemistry of the per-

mitted colors and gives a statement of the limits of tolerance of impurities and a compilation of approved methods of analysis, were published.

Table 1 shows the progress of color certification work during the last four fiscal years:

TABLE 1.—*Coal-tar food dyes certified, 1923-1926*

Year	Straight dyes	Repacks	Mixtures	Batches	Number of firms	
					Total	New
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Number</i>		
1923	250,756.0	20,216.00	239,614.00	633	27	4
1924	232,305.0	26,956.00	286,148.00	724	30	6
1925	315,848.0	39,013.79	284,060.00	883	34	9
1926	311,434.5	32,234.00	304,040.22	1,075	38	14

The figures show that although the gross poundage of dyes examined has not increased greatly, the number of batches has gone up by about 20 per cent, which means a corresponding increase in the analytical work. The number of certifiers has also increased.

#### COLLABORATION WITH OTHER DEPARTMENTS

Other departments of the Government have continued to call upon the bureau for a great volume of chemical work, including the examination of samples and the direction of extended chemical investigations.

One of the chief lines of work is that done with the Post Office Department. Samples of various products for which medicinal claims are made are analyzed by the bureau and evidence is developed to assist the Post Office Department in the prosecution of cases under the fraud order law. The products examined for the year included those making false claims for the cure of kidney and bladder diseases, asthma, catarrh, hay fever, tuberculosis, pyorrhea, rheumatism, lumbago, partial paralysis, pleurisy, pneumonia, venereal diseases, Bright's disease, diabetes, high blood pressure, cancer, and a host of other ills. The samples also included spurious grass seed, various beauty schemes, eye tonic, manhood restorer, fat reducers, and the like.

Samples of drugs were analyzed for the Veterans' Bureau, Federal Trade Commission, St. Elizabeths Hospital, General Supply Committee, and the Government Printing Office. Tea was

examined for the Navy and the Treasury Departments. Insecticides were examined for the Bureau of Reclamation, Public Health Service, General Supply Committee, and Navy Department. Stock feeds were analyzed for the Panama Canal Commission and waters were analyzed for the Federal Trade Commission and the War Department. Samples of paper were tested for the Smithsonian Institution and the Government Printing Office. Bookbinding leather was also tested for the Government Printing Office.

Foods were tested for the Veterans' Bureau, for various branches of the War and Navy Departments, including the Marine Corps, and for the General Supply Committee, Federal Trade Commission, Department of Commerce, Government Printing Office, and the District of Columbia. Samples of turpentine were analyzed for the General Supply Committee.

Several specialists of the bureau served on committees of the Federal Specifications Board, to assist in the preparation of specifications for various items of supplies and equipment purchased by the Government. Technical advice on a variety of subjects was furnished.

#### ENFORCEMENT OF TEA INSPECTION ACT

In carrying into effect the provisions of the act approved March 2, 1897, entitled "An act to prevent the importation of impure and unwholesome teas," 98,551,814 pounds of tea was examined at the various ports of entry. The tea inspection act requires that all tea imported into the United States shall be examined for both



quality and purity, and only such tea admitted as meets the standards set each year by the Board of Tea Experts appointed under the act. Tea inspectors, stationed in the principal ports of entry, work under the direction of the supervising tea examiner, with headquarters in Washington. Samples from the ports are forwarded to Washington for checking in order to obtain uniformity of inspection. A review of the samples sent in during the year indicates that a very high degree of uniformity of inspection exists in all the tea-inspection ports.

The work of examining tea has been greatly facilitated through a recent amendment to the customs regulations providing that all shipments of tea must go to designated tea warehouses. For some time the practice has been to permit teas to be stored in so many different warehouses, especially in New York, that it was impossible for the tea samplers to sample all the

shipments without causing delay. This change in the customs regulations has greatly relieved the situation. Teas are now sampled, examined, and released with a minimum delay.

The tea standards selected by the Board of Tea Experts and approved by the Secretary of Agriculture have been found to be entirely satisfactory. Instead of using the Congou standard for all fully fermented teas, as was done in 1925, the tea board increased the number of standards from six to seven and selected a fully fermented East India tea to be used in examining all fully fermented East India teas. This addition to the standards will be a great help, especially in examining East India teas, where a very close comparison to the standard has to be made.

Table 2 shows the quantity of tea imported during the fiscal year examined at the different tea-examining stations and the quantity rejected.

TABLE 2.—*Tea examined during fiscal year 1926*

Station	Examined	Passed	Rejected	Station	Examined	Passed	Rejected
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>		<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Boston.....	18,163,841	18,047,705	116,136	New York.....	54,410,223	54,080,163	330,060
Chicago.....	3,299,810	3,299,690	120	San Francisco..	10,087,320	10,078,824	8,496
Honolulu.....	336,246	336,246	-----	Total.....	98,551,814	98,094,277	457,537
Puget Sound..	12,254,374	12,251,649	2,725				

The tea-inspection staff passed on all purchases of tea for the Marine Corps, General Supply Committee, and District of Columbia, and recently has taken on the work of passing on all teas for the Veterans' Bureau. Tea examiners also served as customs examiners for the purpose of appraising all tea containers under the tariff act. The tea examiner at New York assists in the purchase of tea for the Navy Department at the Brooklyn Navy Yard. The tea examiner at San Francisco aids the Navy Department in the purchase of tea in the Mare Island Yard for the Pacific fleet.

#### INVESTIGATION OF TYPES OF TEA CONTAINERS

A study of the effects of different types of containers on the keeping of tea was conducted during the year, in cooperation with tea packers, tea-container manufacturers, and tea-container manufacturers' associations. The work already completed has shown that organoleptic tests on tea packed in different containers will enable a tea expert to ascertain the

relative value of types for the keeping of tea and indirectly for the keeping of other food products to some degree. In nearly all cases when samples packed in these different containers are forwarded to tea experts of the trade the trade experts agree with the Government experts as to the comparative value of the containers for the keeping of tea.

The experiments so far have shown that the cost of the container has no bearing on its value for preserving the quality of tea. Some of the cheaper containers preserve as well as the more expensive ones. Although the experimental work on tea containers is only one-fourth completed, the information already gained enables the bureau to give valuable information to the trade in connection with the packing of tea and other food products.

#### ENFORCEMENT OF THE NAVAL STORES ACT

One hundred and ninety samples of turpentine and other paint thinners sold in place of turpentine were col-

lected and analyzed during the year. Of these, 116 samples were found to be pure gum spirits of turpentine, 18 pure steam-distilled wood turpentine, and 8 pure destructively distilled wood turpentine. Thirteen samples of turpentine were adulterated and 17 samples of mineral-oil substitutes were being sold under names prohibited by the naval stores act or were in violation of the act in some other particular. There were issued 8 citations covering shipments of adulterated or mislabeled turpentine and other thinners substituted therefor and 32 citations to hearings covering shipments of badly misgraded rosin. The policy of the bureau in the enforcement of this act, as with the food and drugs act, is to apply educational methods to obtain a compliance with the law whenever possible, the punitive sections of the act being invoked only when other means are ineffective. In nearly all cases compliance with the requirements of the naval stores act was obtained. In a few cases prosecution is under consideration. A comparison of the foregoing figures with data compiled on the extent of adulteration and misbranding of turpentine existing prior to and shortly after the passage of the naval stores act shows that a purchaser of small quantities of turpentine in the open market is much more sure of obtaining a pure product correctly labeled and sold—that is, of getting what he asks and pays for—than ever before.

Fifty-one lots of rosin, totaling 5,725 barrels, were examined and graded upon request. Seven samples of turpentine were analyzed for persons requesting such analysis under the naval stores act.

A conference of representatives of the naval-stores industry was held to discuss the proposed establishment of grades or designations for crystal rosin and rosin containing dirt and specks. This brought out a preponderance of opinion from those present against the promulgation of separate grades or standards. The matter is still under investigation. Government rosin graders are not permitted to designate dirty and specky rosin in the usual manner—that is, by drawing a circle around the grade mark. If the grader believes that the rosin is too specky or dirty to be graded as one of the standard grades set forth in the naval stores act, he has no alternative but to refuse to grade it as rosin of any recognized grade.

A conference of Federal rosin classifiers was held for the purpose of establishing, by check grading a large number of representative rosin samples by several experienced and careful graders, the maximum allowable or possible variation.

A survey was made throughout the entire naval-stores producing territory for the purpose of checking up on the grading of rosin stocks held ready for shipment at the stills and concentration points. This survey showed the producers of rosin and their inspectors the degree of accuracy of their grading and the causes of misgrading. Due notice of the need for improvement was given wherever serious misgrading was found. Investigations following this survey have shown that rosin moving from certain parts of the South to northern distributing and consuming points is much more accurately graded than ever before.

## ENFORCEMENT OF THE FOOD AND DRUGS ACT

The close of the fiscal year marks the twentieth anniversary of the Federal food and drugs act, which became a law on June 30, 1906. The intervening period has been one of extraordinary development in the food industries and of steady improvement in effective food and drug control by the Federal, State, and Municipal Governments.

Progress in effective food control has been due principally to three factors:

- (1) The gradual transfer of the manufacture of food from the home to the factory. Before the advent of food legislation much of the food con-

sumed was produced in the home or in the immediate neighborhood of the home, so that consumers knew where and how it was made, of what it was composed, by whom it was handled, and whether or not it was kept under sanitary conditions. As the manufacture of food was transferred to the factory and foods were shipped for longer and longer distances it became increasingly difficult for consumers to know much about the food they bought. At the present time few city consumers have any personal knowledge of the methods of production, manufacture, and handling of the food they eat, and a larger and larger pro-



portion of food now consumed on the farms is purchased at the grocery.

(2) Advances in the sciences of chemistry and bacteriology have enabled the food official to detect with a greater degree of certainty various forms of adulteration and misbranding and they have also furnished the food manufacturer with tools for the more effective control of his processes.

(3) The enactment of more effective legislation, the interpretation of such legislation by court decisions, and the education of food industries by the various State, Federal, and municipal food officials have been potent factors in making food-law enforcement more effective. The educational work has been both in the nature of informing the food industry of the requirements of the law and of the regulations issued thereunder, and in the nature of helping the industry to improve its processes to insure a better product and one that more nearly complies with all of the provisions of food-control legislation.

The 20-year period of the Federal food and drugs act has brought about also a marked change in the problem of food officials, in the viewpoint of leaders in the food industry, and in the attitude of the consuming public.

In the beginning food officials were confronted with the necessity of charting out the course of action and making precedent decisions of vital interest to great food industries and to the consuming public without the guidance of interpretive court decisions and sometimes without adequate scientific data. It was sometimes necessary in those early days of food-law enforcement work to make prompt decisions. In many instances it was impossible to wait until the courts could pass upon questions and until extensive scientific investigations could be completed to furnish complete data upon the questions at issue. There were conflicting opinions among food officials, leaders of the food industries, and others vitally concerned with the problems involved in the enforcement of the new legislation. During the last 20 years many of the problems which confronted the food officials in the early days have been solved. The higher courts have rendered numerous decisions, which have clarified the meaning of the law and have shown more clearly its limitations. The food officials and the food industries know to-day better than ever before exactly what constitutes adulteration and misbranding under the Federal food and drugs act. Much light has been shed

upon these troublesome problems, not only by precedent court decisions, but also by data that have been accumulating through extensive scientific investigations relating to the problems involved. Although great improvement has been made in this respect and many of the vexatious problems have been solved, yet food-law legislation is still comparatively new and much remains to be done in the way of determining the meaning of the law in its application to varying conditions in the food and drug industries and there is still need for further progress through scientific investigations to improve the processes of manufacturing, transporting, storing, and utilizing food materials.

The principal problem of the food administrative officer to-day, however, is not the determination of the meaning or the limitations of the law but rather the determination of questions of fact and the procuring of evidence adequate to the establishment of court action within the limitations laid down by the numerous judicial decisions. The problem of food-law administration, through the elucidation of appellate decisions and the data of scientific investigations, has been tremendously simplified. The procurement of necessary evidence and the organization of such facilities as will procure this evidence most efficiently and economically are now the primary problems of the enforcing agencies.

The viewpoint of the leaders of the food industry has changed with the progress in food-law enforcement. When Federal food legislation was first under consideration by Congress many in the food and drug industries vigorously opposed the enactment of such legislation, believing that it would harass trade and be of little or no benefit to their industries. Others in the food industries, though not hostile to such legislation, looked upon it rather as a necessary evil than as desirable from their point of view. A few leaders in the food industry had the vision to see from the first that such legislation, if properly enforced, would be of constructive benefit to the food industry as well as a protection to the public. With few exceptions, the leaders in the food industries now look upon food-control legislation as of very great benefit to the food industries. They have found that food officials have been able to assist them in many practical ways in improving their processes and their products. Their attention has been directed to the need for effective technical fac-

tory control, and they have found such control to be of very great value to them, not only in enabling them to meet the requirements of the law but also in improving their products and in effecting more economical production. Perhaps the greatest benefit that has come to the food industry through efficient food-law enforcement has been the increased confidence of consumers in the purity and wholesomeness of the food supply of the Nation.

To-day the leaders in the industries, with few exceptions, also support the fair enforcement of the food law. Those in the food industries who are opposed to food-law enforcement are confined principally to a few individuals who desire deliberately to adulterate and misbrand their products. To-day the vast majority in the food industries accepts with confidence the conclusions of food officials and adopts loyally and with finality administrative decisions which are rendered, because they are recognized not only as legal but as constructive from the standpoint of the best interests of the industry itself.

The change in the attitude of the public has been no less marked. Before the days of effective food-control legislation the public looked upon all food, especially that in package form, with suspicion. Too frequent experience in buying adulterated and misbranded foods made them wary of all foods. This attitude upon the part of the public was intensified by exaggerated rumors regarding forms of adulteration that were prevalent. In those days sanitary conditions in some food factories were disgusting, if not revolting. The occasional use of harmful preservatives made the public attribute almost every illness of unknown origin to adulterated food.

The enactment and the enforcement of the Federal food and drugs act and State food legislation has restored the confidence of the public in the purity and wholesomeness and truthful labeling of the food supply of the Nation. So marked has been this change that many consumers are sometimes too complacent in regard to the food supply. Some consumers, relying upon the efficiency of the enforcement of food laws, do not take the trouble to read labels on the packages of food they buy, nor do they inspect the contents with any degree of care. They expect food officials to do what only the buyers themselves can do. It was never intended that food-law legisla-

tion should relieve consumers of the duty of carefully inspecting the food they buy. Vigilance on the part of consumers, as well as on the part of officials, is necessary for the full protection of the public.

This complacency on the part of the public is also reflected to some degree in its apparent indifference to proposed amendments to the Federal food and drugs act, which would greatly weaken its effectiveness and let down the bars to adulteration and misbranding. Within the last year or two amendments to the act were introduced in Congress which would permit certain highly objectionable forms of adulteration. The public as a whole has given little indication that it is concerned about these attempts to weaken food and drug control legislation.

#### PLAN OF OPERATION

The volume and value of the food and drug products which enter interstate commerce and which are imported into this country are enormous. To supervise this traffic effectively with a force which is necessarily limited it is essential that a systematic plan of operation be adopted. Accordingly a project system has been put into effect by the bureau. The various types of food and drug products which come within the scope of the act are divided into classes or projects, such as canned goods, cereal products, fruit and fruit products, cattle feeds, proprietary medicines, and pharmaceutical products.

It is a well-established fact that the majority of American food and drug manufacturers are doing an honest and legitimate business. If the products of these ethical manufacturers can be eliminated from consideration, the efforts of the bureau may be concentrated on that very small proportion which is deliberately, negligently, or unknowingly violating the law in some respects. In order to determine which manufacturers are complying with the law, factory inspections of a very thoroughgoing character are made by trained inspectors. The visits of these inspectors are ordinarily heartily welcomed by the manufacturer who is doing a legitimate business. Where admission to an establishment is refused the information necessary to determine whether infractions of the law are occurring can be obtained by the collection of samples on the market and chemical analysis in the laboratories. Through



the medium of these factory inspections, as well as by means of chemical analysis when necessary, it is possible to determine what particular food and drug commodities are adulterated or misbranded and what particular types of violations are to be anticipated, and to segregate the comparatively small section of the industry which is doing a questionable business.

With this information available the bureau is able at the beginning of each year to formulate comprehensive plans for the enforcement of the law in a uniform manner throughout the United States. The field agents are fully advised of these plans and work in harmony with them. The plan of operation is made sufficiently flexible, so that should an emergency arise, for example, an outbreak of food poisoning, the less important lines of operation may be set aside and efforts concentrated on tracing and removing from the market the product involved.

Where the preliminary inspection made by the field force has revealed a type of violation requiring correction, several courses of action are open. If it appears that the infraction is one of a deliberate character, damaging the health or the pocketbooks of consumers, there is no justification for withholding an application of the punitive section of the law. If, for example, a manufacturer is found deliberately shortweighting his product or so negligently controlling his output as to result in serious shortages even in the absence of deliberation, or if a substitution of a low-priced article for a high-priced one, such as the adulteration of maple sirup with glucose, is encountered, no ground exists for the exercise of leniency and immediate steps are taken to remove the product from the market by seizure and also to prosecute the offending individual or firm through the criminal section of the law. If, on the other hand, the infraction is one which appears to be the result of a misunderstanding and the ensuing damage to the public is not of such a character as to require immediate removal of the goods from the market, it is the practice before initiating action to give notice to the trade advising that on or after a certain date legal action under the food and drugs act will be instituted if continued violations are encountered. Where the facts seem to warrant it such notice may be preceded by a public hearing at which interested persons are accorded opportunity for free discussion. Disinterested experts are freely consulted to

supplement facts derived from investigations in reaching conclusions as to the proper administrative procedure.

The Federal food and drugs act provides for the prosecution of the person or concern responsible for violating its provisions and for the seizure of the adulterated or misbranded products. Seizure actions are instituted in four classes of violations: (1) In the case of food products containing added poisonous or other added deleterious ingredients which may be harmful to health; (2) in the case of food products consisting in whole or in part of filthy, decomposed, or putrid animal or vegetable substance, or any portion of an animal unfit for food, or a product of a diseased animal, or one that has died otherwise than by slaughter; (3) in the case of food or drug products so grossly adulterated or misbranded with false or fraudulent claims that their distribution constitutes a serious imposition upon the public; (4) in the case of deliberate frauds in the shipment of adulterated and misbranded food products which seriously demoralize legitimate trade practices. Unless a violation falls clearly within one of these four classes seizure action is not taken, but the party responsible for the violation may be prosecuted.

The Federal food and drugs act is administered on the theory that more is to be accomplished by acting in an advisory capacity under such conditions as will insure legal products than by accumulating a record of successful prosecutions with attending fines. In this belief the bureau is always willing to advise a manufacturer coming to it with an honest desire to comply with the act as to the conditions which he should observe in marketing a fully legal product. It is believed that more effective compliance with the law may be obtained by showing reputable manufacturers how to bring their products into conformity with its terms than by imposing fines or effecting seizures and confiscations after the violation has been committed. Its policy, therefore, is to pursue educational methods as a preliminary to legal action where this can be done without jeopardizing the public interest or legitimate competitive conditions.

Two instances of how the project plan of operation and the policy of using educational methods under certain conditions work out in actual practice may be cited.

A few years ago a survey showed that canned blueberries from Maine contained excessively large quantities of maggoty berries. Several shipments

of the adulterated blueberries were seized in various parts of the United States. Cannerymen and growers claimed that it was impossible to reduce materially the number of maggots in the berries. The blueberry-canning industry was informed that it would be absolutely necessary to eliminate maggoty blueberries shipped in interstate commerce, as maggots in canned food constitute a violation under the Federal food and drugs act. The blueberry-canning industry was threatened with ruin. Blueberries are the chief crop of one county in Maine, most of these berries being marketed after they have been canned. The entire livelihood of many people was threatened unless means could be found to put up a legal product.

Staff specialists were sent from the bureau to study the situation, working in collaboration with the State officials, who were also interested in the problem. As the result of the study of specialists an apparatus was devised by means of which it is possible to eliminate maggoty blueberries. During the first season after its invention this device was used by a few cannerymen with marked success. During the next season a still larger number of cannerymen used it and had no difficulty in putting up a product that met the requirements of both Federal and State food laws. During the season of 1926 practically all of the principal cannerymen adopted means that insured a legal product. Federal and State food inspectors patroled the cannerymen to assist in eliminating maggoty blueberries and to see that the canned product in every way met the requirements of the law. Thus the educational methods followed by the Federal and State food officials have been effective in saving an industry great losses and in enabling consumers to obtain a product free from objectionable material.

Surveys of the sardines packed in Maine in past years showed that a large portion of fish which had undergone a form of decomposition known as "belly blown" was included in the pack. Numerous shipments of decomposed sardines were seized and an extensive educational campaign to demonstrate methods for putting up a good pack was carried on for several years.

A comprehensive survey of the Maine sardine-packing industry was made during the past year. Each of the packing plants, about 40 in number, was visited five or six times during the season to ascertain whether or not the educational work done among the packers through the past

several years had been effective. About 100 investigational and nearly 150 official samples were collected and analyzed. This resulted in seizure of 21 shipments, covering 3,682 cases of adulterated and misbranded sardines. These seizures were in every instance cases packed during 1924. So successful were the educational and regulatory campaigns of previous years that, notwithstanding comprehensive sampling this year, no goods of this season's pack were found of a character warranting a recommendation for seizure.

A reorganization of the regulatory work involved in the enforcement of the food and drugs act, the tea inspection act, and the naval stores act was effected during the year, all such work being placed under the immediate supervision of an assistant chief appointed for the purpose.

Food-control work in the United States suffered a severe loss in the death on April 25, 1926, of R. E. Doolittle, chief of the central inspection district of the bureau. Mr. Doolittle entered the service of the bureau in 1904 as chief of the New York station to enforce an act controlling imported foods and drugs. He had previously served as a State food-control official in Michigan. Since the enactment of the Federal food and drugs act Mr. Doolittle has been active in food-control work, having served as chief of the eastern inspection district, chief of the central inspection district, member of the Board of Food and Drug Inspection, and member of the Food Standards Committee.

#### COOPERATION WITH STATE AND CITY OFFICIALS

Dovetailing into the activities of the bureau are the functions of the various officials who enforce State food and drug laws. Many of these laws are identical with or very similar in phraseology to the Federal act. Obviously it is in the interest of good business that State and Federal laws be uniformly enforced; otherwise manufacturers are continually harassed by the necessity of complying with varying requirements. As a means of promoting uniformity of State and Federal action the bureau has maintained for more than 10 years an office of State cooperation, presided over by a competent official, who has had both State and Federal experience. The duties of this official are to maintain constant contact between the State and Federal offices, keep the State officials as fully informed as to



policies of enforcement as are the field forces of the bureau, supply them with information regarding violations which require their attention, and, in turn, obtain from them information on matters needing the attention of the bureau. There is a generous interchange of information on methods and practices, and, as authorized by the Fed-

eral act, many State officials collect samples of products subject to the law.

### PROSECUTIONS AND SEIZURES

The food and drug products involved in court actions instituted during the year are listed in Table 3.

TABLE 3.—*Summary of prosecutions and seizures by the Bureau of Chemistry during 1926*

Product	Prosecutions	Seizures	Total	Product	Prosecutions	Seizures	Total
Alimentary paste.....	6	4	10	Flour.....	8	2	10
Baked products.....		5	5	Fruit.....			
Beverage ingredients (malted milk).....		1	1	Fresh.....	7	26	33
Beverages.....		1	1	Canned.....	0	33	33
Cereal products.....		3	3	Dried.....	46	6	52
Chocolate coating.....		3	3	Jellies.....	9	28	37
Cocoa.....		2	2	Maple sugar.....	4	0	4
Coffee.....	14	10	24	Mince meat.....	0	1	1
Confectionery.....	9	3	12	Mustard.....	8	0	8
Dairy products:				Nuts.....	0	34	34
Butter.....	59	143	202	Oils.....	54	10	64
Cream.....	2	0	2	Oleomargarine.....	1	3	4
Milk (condensed).....	0	1	1	Paste (almond, lemon).....	0	3	3
Drugs:				Sauerkraut.....	0	2	2
Crude drugs.....	0	4	4	Sirups.....	0	6	6
Remedies.....	92	169	261	Spices.....	4	3	7
Eggs:				Tea.....	0	1	1
Shell.....	16	29	45	Vegetables:			
Frozen.....		13	13	Canned.....	53	114	167
Feeds.....	52	92	144	Fresh.....	1	0	1
Fish:				Vinegar.....	0	2	2
Canned.....	22	37	59	Water.....	0	7	7
Shell.....	24	44	68				
Flavoring extracts.....	0	3	3	Total.....	491	853	1,344

### STAFF-CONTROL LABORATORIES

Staff-control laboratories are maintained to develop information on which to base administrative action in the enforcement of the Federal food and drugs act. These laboratories conduct investigations relating to the composition, manufacture, storage, preservation, and methods of handling of food and drug products. Methods of analysis for detecting adulteration and misbranding are developed, and information to be used in the planning of regulatory campaigns is furnished. The staffs of these laboratories review cases developed by the field force when special technical questions are involved. They assist the field force in planning and carrying out surveys and campaigns to bring about compliance with the Federal food and drugs act. The results of their work are reflected in the progress made in the control of food and drugs. Some of the lines of work for 1926 in which they have rendered assistance have already been outlined.

Mention may be made of other investigations carried on by them during the year.

### DRUG-CONTROL INVESTIGATIONS

The survey of pharmaceutical products begun three years ago has been practically completed. A sufficient number of samples of pharmaceutical products from each manufacturer in the United States has been analyzed to furnish a fair estimate of the character of the output of this industry. Through the earnest effort of the industry itself, in cooperation with the bureau, a very general improvement in the quality of these important products has been brought about. Although no evidence of any deliberate substitution or other deliberate adulteration in drug products has been discovered, the survey demonstrated the necessity for increased care on the part of many manufacturers, and in most cases such additional supervision has been installed. The manufacture of pharmaceuticals is a highly

specialized profession, requiring unusual care and skill from the receipt and examination of crude materials to the packaging and labeling of the finished products. Many of the medicaments used are powerful poisons as well as valuable therapeutic agents. It is vitally important that these preparations conform in strength and purity with the representations under which they are sold. The manufacturers' contact committees mentioned in the 1925 report of the chemist have given most helpful cooperation.

Special attention has been given to the character of the representations made by manufacturers of medicines intended to be sold directly to the public. The Federal food and drugs act provides essentially that therapeutic representations made for medicines shall not exceed the limitations of the ingredients of which they are composed. The manufacturers in general cooperate heartily in effecting any needed revision in the labels of their products. In order to systematize the work, as well as to avoid discrimination among competing manufacturers, these products have been handled by classes rather than as isolated individuals. The labelings of many proprietary medicines have been the subject of action, with a view to bringing the therapeutic representations more closely into harmony with present-day medical opinion.

A general investigation of ether was made during the year. Ether is perhaps the most generally used of all anesthetics. Administered in serious emergencies, it is essential that only the purest ether be permitted for sale as an anesthetic. Investigation showed that some of the ether on the market intended for anesthesia contained peroxide, aldehyde, excess acid, or excess non-volatile matter, bringing it below the standard prescribed by the United States Pharmacopeia and therefore making it adulterated under the Federal food and drugs act. A number of consignments of such ether have been seized and thus effectively removed from the possibility of use as an anesthetic. The principal manufacturers of ether have recently held a conference to discuss methods for guarding against the possibility of contaminating ether with objectionable impurities. It is highly probable that as a result of this conference and of the researches initiated thereby important advances in the art of manufacturing, packing, and preserving ether may be effected.

Ethylene has recently come into prominence as an anesthetic. An investigation of this gas, as found on the market, was inaugurated.

A number of investigations have been undertaken for the purpose of adding to the existing knowledge on the composition of drugs and methods for their analysis. It has been found that the present methods for the analysis of ipecac and hyoscyamus indicate a content of alkaloidal constituents in these drugs considerably below the truth. During the year there has been established a laboratory the primary function of which is to study the methods of drug analysis, in order that accurate information may be available for the use of analysts of the bureau and also that chemists generally may have the benefit of the researches.

#### FOOD-CONTROL INVESTIGATIONS

The study of the composition of alimentary pastes and of the raw material used in their manufacture was continued. A method of determining the moisture content of alimentary paste in its original unground condition was developed. Moisture determinations were made on farina, semolina, and egg pastes by the ordinary vacuum-oven method and the rapid-routine method, not only by using the regular drying periods but also by extending the periods to ascertain if there was a point beyond which there would be no loss in weight. No such point was found, however. Five hours' drying by the vacuum method gave results which checked with those obtained by the rapid-routine method in one hour. Ten hours' drying by the vacuum method corresponded to two hours' drying by the routine method, and so on. No advantage was found in extending the drying periods for products of this kind beyond the periods given in the two methods.

A brief study of the ethyl acetate content of distilled vinegar was made.

Reports on the methods of analysis of baking powder and baking chemicals and of bread were made to the Association of Official Agricultural Chemists. Variations in the method of handling doughs and the influence of the amount of salt in the dough batch were studied. Work was continued on wheat flour, its manufacture, grading, and use. An article upon the quantitative determination of unsaponifiable matter in wheat flour, alimentary pastes, and eggs was published during the year. A careful compari-



son of the moisture content of 20 selected samples of flour was made by the vacuum-oven method, the rapid-routine method, the water-oven method, and the Bidwell-Sterling method.

A study of the effect of aging on the fat constants of cheese was completed. Much work has been done on malted milk, including a review of the literature and manufacturing processes and general information regarding chemical analysis. The constants of the fat extracted from four well-known brands were determined, the results showing a decided variation. The subject of methods for determining casein emulsifiers in processed cheese was given attention, principally a determination of citrates by the pentabrom-acetone method.

Experimental work on fruit jellies, preserves, and butters was undertaken. It included the analyses of samples of strawberries, strawberry juice, apple pomace, and cranberries.

A survey of the shrimp-packing industry was made, and experimental packs of shrimps were put up. Preliminary work has been done on Scotch-cured herring.

Work was carried on upon the direct determination of the total milk protein content of milk chocolate, this attempt replacing that previously made to determine casein alone directly, and to estimate the remaining milk protein by a factor. The method has been developed to a point where results can now consistently be obtained within 0.2 per cent and usually within 0.15 per cent of the calculated value.

In collaboration with the pharmacological laboratory, work was carried out on the toxicity of tin. A modification of a colorimetric method for the determination of lead has been developed.

#### MICROBIOLOGICAL INVESTIGATIONS

The occurrence of several cases of botulism called for a restudy of the problems surrounding the occurrence of this disease as a result of the consumption of canned food. The examination of canned sardines from a pack accountable for two outbreaks, resulting in four deaths, furnished important evidence of the necessity for demanding that canned foods offered for human use should comply with all requirements for soundness not only in the food examination but in the absence of those marks which ordinarily give warning of spoilage. A large percentage of cans in this pack,

although perfectly sound, were so full that they bulged, giving the appearance usual in incipient spoilage. Unfortunately, in addition to these perfectly sound but slightly bulging or springing cans, a small number of actually swelled cans containing poisonous material was also present. It was clearly shown that dealers and consumers, becoming accustomed to this abnormal appearance of a sound pack, lost the necessary discrimination which would have resulted in the elimination of the bad product. This series of observations was so strikingly conclusive that the trade has formally recognized the necessity of insisting upon a rigid inspection of all canned food at every point in the distributing line and the removal of all abnormal-appearing products, such as swells, springers, and flippers of all degrees, from the channels of trade.

For many years reports of bacteriological and chemical investigations of oysters have been accumulating in the files of the bureau, and for more than a quarter of a century investigators have been presenting in scientific and technical journals the results of their investigations of various problems dealing with the handling of oysters. The unpublished data filed in the bureau and a summary of other information available on the bacteriology and chemistry of oysters have been compiled with a view to their publication as a department bulletin.

The occurrence of human food-poisoning cases attributed to cheese has been frequently recorded over a long period of years. There is reason to believe that these cases were more frequent in the early days of factory cheesemaking in the United States than they are now. Nevertheless they still occur and in most cases their interpretation has baffled the skill of both the chemist and the bacteriologist. During the past year it has been possible to demonstrate the occurrence in two such cases of a streptococcus capable of producing illness. The demonstration of this organism opens up an entirely new field of food poisoning, fortunately limited, so far as the experimental results thus far show, to milk and its products.

An investigation of the bacteriology involved in the curing of certain fish products was begun. There are imported into the United States from the Scandinavian Peninsula, Scotland, France, Italy, and Spain, as well as from the Orient, large quantities of various pickled and salted fish products. Alaska also produces salted herring

packed in the Scotch or Norwegian style. Such imported products as anchovies in salt, sardines in salt, filets of sardines, Scotch-cured herring, Norwegian-cured herring, kryddersild, appetitsild, gaffelbiter, sardelrings, Bismark herring, Kaiser-Friedrich herring, roll-mops, milt-herring, delicatessesild, suresild, and smörgaassild are marketed in this country for consumption mostly by an alien population. Our lack of knowledge of the curing process and of the nature of the normal and abnormal products obtained makes it necessary that biological and chemical investigations of the process be conducted. The chemical work for this investigation is being done in the food-control laboratory. The bacteriological work up to the present time has consisted mainly in collecting and examining samples of some of the fish products on the market, with a view to determining the types of predominating bacteria. The predominating groups of organisms in all the samples examined are acid-producing streptococci, resembling the lactic-acid streptococci. In some of the samples there were typical lactobacilli. The results so far obtained are significant in showing that the bacterial flora is almost entirely Gram positive in character and is composed mainly of streptococci, lactobacilli, spore-forming anaerobes, and aerobic spore formers.

#### MICROCHEMICAL INVESTIGATIONS

A method was developed for testing cherries as received at the factory to determine the amount of infestation by maggots. By means of this method it is possible for factory managers to ascertain the percentage of cherries that contain maggots in each delivery and to refuse those offerings which are unfit to pack. As a result, the cherries packed during the last season were far more free from these pests than the packs of previous years.

A process was developed and a machine devised for removing maggots from blueberries, a very serious pest in Maine. The total value of the pack has been estimated at from \$700,000 to \$1,000,000, and it is believed that the machine devised for eliminating the maggots was responsible for saving a large proportion of the crop.

#### PHARMACOLOGICAL INVESTIGATIONS

Work was continued to determine whether food contaminated with tin is injurious to health. Most of the

pharmacological work heretofore done has been with tin which was added to food in the form of tin salts and not with food contaminated from the usual sources. Experiments were conducted with pumpkin containing tin from corrosion and also with pumpkin to which tin had been added. The purpose of the experiments was to determine (1) if there was any apparent difference between the added tin and that occurring there naturally because of corrosion and (2) if tin in the combinations fed is absorbed and deposited in the body. All guinea pigs used in the experiments, whether fed the pumpkin to which tin was added or that containing tin from corrosion, grew well and appeared healthy. There was therefore no outward evidence of harm. No tin was found deposited in the organs analyzed (liver, kidneys, and spleen).

In collaboration with the Bureau of Biological Survey the manufacture on a commercial scale of a stable rat poison in powder form from squill bulbs has been developed. This product has the advantage of cheapness, efficiency, and apparently little likelihood of killing other animals exposed to poisoned rat bait.

Work was continued on bioassay standards of fluid extract of ergot, fluid extract of cannabis, pituitary powder, epinephrin, and ouabain. These have been prepared and distributed upon request to 24 American manufacturers. Standards have also been supplied to individuals, in Canada, Spain, Belgium, Austria, and Hungary. Through the use of these standards in bioassay tests greater uniformity in the potency of certain United States Pharmacopœia drugs will be effected.

#### PRODUCTS ALLEGED TO BE RADIOACTIVE

A nation-wide survey of products alleged to be radioactive was completed during the year. Samples of hair tonics, bath compounds, suppositories, tissue creams, tonic tablets, face powders, ointments, mouth washes, demulcents, opiates, ophthalmic solutions, healing pads, and other preparations in solid, semisolid, and liquid form were analyzed for their content of radium. About 60 samples, representing the product of 20 manufacturers, were examined. Of these only three contained radium in sufficient quantities to be of therapeutic value, and then only in certain very limited cases. Therapeutic claims of an ex-



aggregated nature are being made for many of the products examined. One curious sample consisted of a short glass rod, coated on one end with a yellow substance and inclosed in a glass bulb. The bulb is supposed to be hung over the bed, when according to the claims of the inventor it causes the dispersion of "all thoughts and worry about work and troubles and brings contentment, satisfaction, and bodily comfort that soon results in peaceful, restful sleep."

### INSPECTION OF IMPORTED FOODS AND DRUGS

The Federal food and drugs act provides that shipments of foods and drugs offered for entry into the United States which are found to be adulterated or misbranded within its meaning or which are otherwise injurious to health shall be excluded from this country. Inspections are made of the invoices and public store cases covering all shipments of the foods and drugs offered for entry at the leading ports. Not all shipments offered for entry are actually sampled, however, because the nature of many shipments offered for entry makes sampling unnecessary and the limited personnel would make it impossible. Sampling is largely confined to products or shipments which Government officials have reason to suspect of being adulterated or misbranded. Furthermore, in order to obtain a survey of the whole field, a schedule for an intensive sampling of certain products selected each year is followed.

### FOOD STANDARDS

The joint committee on food standards and definitions, which consists of three representatives each of the Bureau of Chemistry, of the Association of American Dairy, Food, and Drug Officials, and of the Association of Official Agricultural Chemists, prepares standards and definitions of food products for the guidance of officials in the enforcement of food control laws.

This has been a year of accomplishment. Although but two regular meetings of the committee were held, more time than usual was devoted to the work and a determined effort was made to complete the revision of certain schedules which have been in controversy for a number of years.

New standards were adopted for almond paste and kernel pastes, for sauerkraut, and for Dutch-process

chocolate and Dutch-process cocoa. Revisions of the extended schedules for meat and meat products and fruit and fruit products were completed. The standard for butter was amended so as to conform with recent legislation. The standards for moisture in flour, and for glucose, Pasteurized milk, evaporated milk, evaporated skimmed milk, sweetened condensed milk, sweetened condensed skimmed milk, malt vinegar, and wine vinegar were amended. Faulty or obsolete definitions and standards for self-raising gluten flour, diabetic food, canned pea grades, blended milk, and sterilized milk were revoked.

Hearings were held upon the subjects of alimentary pastes, wheat flour, fruit and fruit products, and so-called process cheese. The hearings upon the moisture content of wheat flour and upon fruit and fruit products, particularly with reference to the increasing use of pectin and pectinous products, were of especial importance. Minor changes, mainly editorial in character, were recommended with respect to the revision of Circular 136, Office of the Secretary. The following subjects were considered, although action was postponed: Sweet cream butter, ice cream, whipping cream, sirup, and process cheese.

It is gratifying that these definitions and standards are being increasingly accepted by food officials in States having no special legislation providing for their recognition. The food-control officials in Louisiana, Mississippi, and Texas have recently adopted the definitions and standards for sirups and molasses, thereby harmonizing their regulations and procedure and promoting uniformity in food-law enforcement throughout the States.

### PUBLICATIONS ISSUED

Eight department bulletins, including one revision, four miscellaneous circulars, including one revision, two food inspection decisions, the report of the chemist, three articles in the Journal of Agricultural Research, 850 notices of judgment, 1 index to notices of judgment, 1 book, and 102 articles in scientific and technical journals were published during the year.

The miscellaneous circulars are: No. 9, Importation and Inspection of Tea (revision); No. 22, Supplement 1, Amendment to Regulations for the Enforcement of the Naval Stores Act; No. 22, Supplement 2, Notice of Establishment and Promulgation of a Stand-

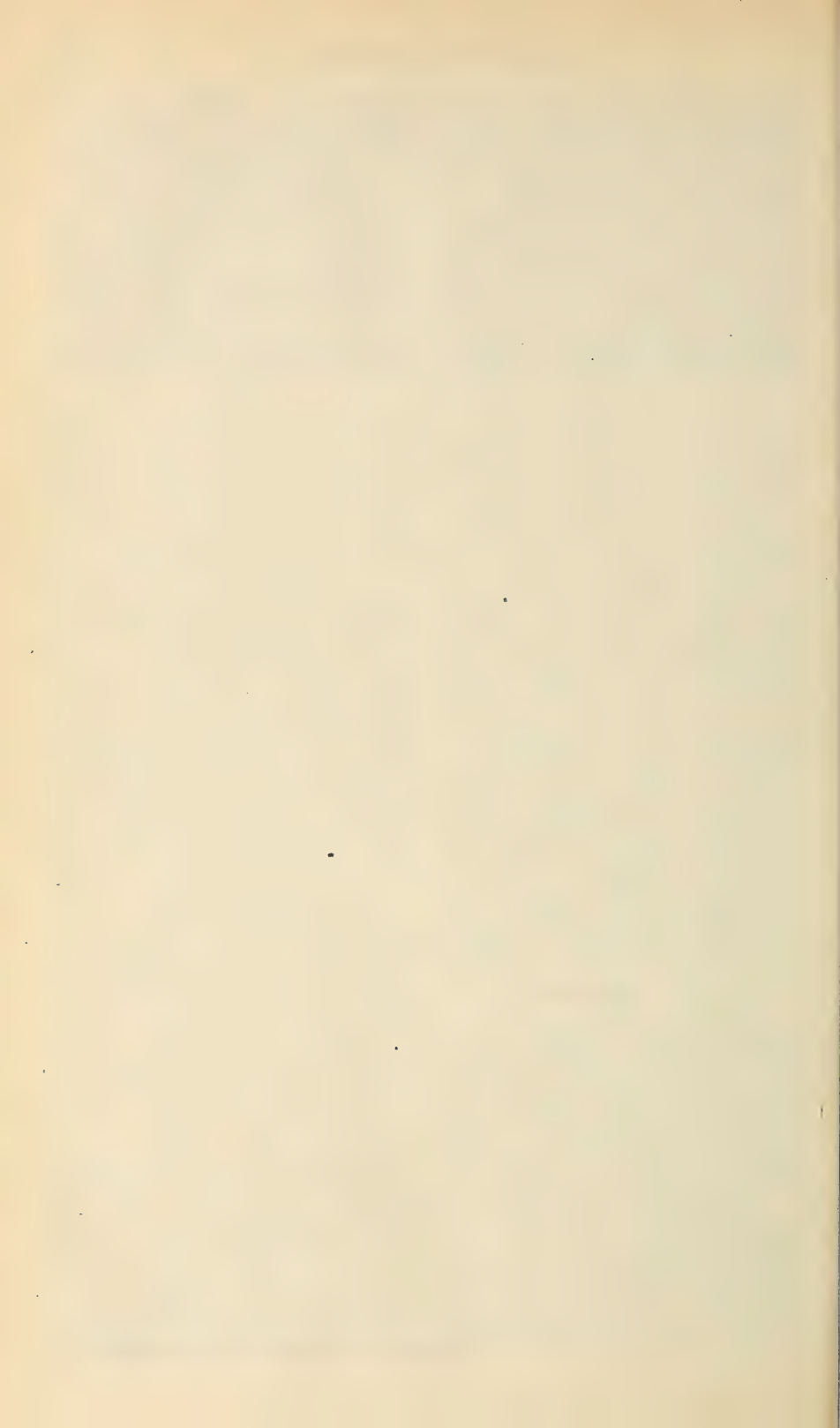
ard for Opaque Rosin; and No. 52, Certification of Coal-Tar Food Colors.

The food inspection decisions are: No. 196, Sauerkraut, and No. 197, Almond Paste and Kernel Pastes.

The department bulletins are: No. 824, Insect Powder, by C. C. McDonnell, R. C. Roark, F. B. LaForge, and G. L. Keenan (revision); No. 1335, Commercial Dehydration of Fruits and Vegetables, by P. F. Nichols, Ray Powers, C. R. Gross, and W. A. Noel; No. 1345, Salt Bushes and Their Allies in the United States, by G. L. Bidwell and E. O. Wooten (B. P. I.); No. 1370,

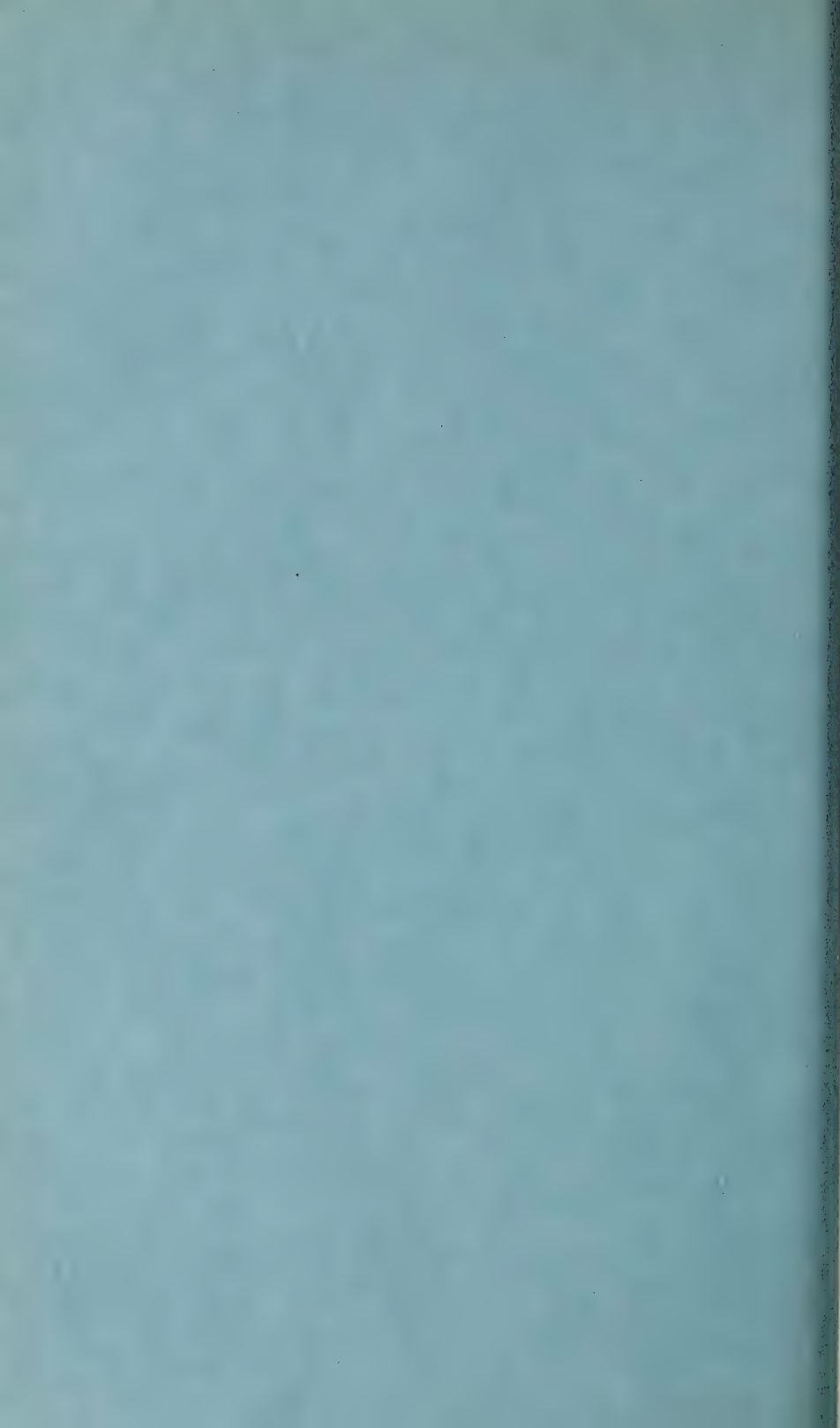
Sugarcane Sirup Manufacture, by H. S. Paine and C. F. Walton; No. 1371, Effectiveness Against the San Jose Scale of the Dry Substitutes for Liquid Lime-Sulphur, by W. S. Abbott and J. J. Culver (Ent.) and W. J. Morgan; No. 1373, Dust Control in Grain Elevators, by H. R. Brown and J. O. Reed; No. 1389, Deterioration of Commercially Packed Chlorinated Lime, by C. C. McDonnell and Leslie Hart; and No. 1390, Chemistry and Analysis of the Permitted Coal-Tar Food Dyes, by J. A. Ambler, W. F. Clarke, O. L. Evenson, and H. Wales.











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## REPORT OF THE CHIEF OF THE BUREAU OF DAIRY INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF DAIRY INDUSTRY,

*Washington, D. C., August 4, 1926.*

SIR: I have the honor to submit herewith a report of the work of the Bureau of Dairy Industry for the fiscal year ended June 30, 1926.

Respectfully,

C. W. LARSON,  
*Chief of Bureau.*

Hon. W. M. JARDINE,  
*Secretary of Agriculture.*

The activities of the Bureau of Dairy Industry during its second year as a bureau of the department have been directed to investigations most urgently needed by the dairy industry.

Two lines of study which needed greater attention were those dealing with economical milk production and the utilization of skim milk and whey—the by-products from the manufacture of butter and cheese. Since no additional funds have been available during the year, the increasing of activities in these lines has necessitated the decreasing of others.

The problem of economical milk production has been attacked through studies in milk secretion and dairy-herd improvement. The accomplishments in this work and the need for fundamental information justify expansion of the work so that the lessons that may be derived from these studies will not be too long delayed.

The preliminary results of studies on the effect of certain practices in feeding upon reproduction have been so encouraging, and the need is so important, that this field of research should be enlarged during the coming year.

Investigations in the utilization of by-products have led to the discovery of new products and new uses for a considerable quantity of by-products. Notable work has been done with concentrated sour skim milk, dried albumin products, milk sugar, and the utilization of dry skim milk in bread making.

Fundamental studies involved in ice-cream manufacture have been continued. Before much progress can be made in the actual process of ice-cream making, more information must be obtained regarding the mechanism of the physical reaction which takes place when the mixture to be used for the ice cream is actually frozen.

New problems in milk sanitation and plant management have been undertaken.

The addition of new tabulating machinery to the equipment of the bureau has greatly enlarged its usefulness to members of cow-testing associations. It is now possible to analyze these records promptly and in greater detail, most important of which is the determination of the value of the sires in use in the herds.

The work at the farm and field stations has been systematized and definite programs of investigations gotten under way.

This report undertakes to record only a brief summary of the status of the most significant accomplishments of the bureau during the past fiscal year.

### DAIRY RESEARCH LABORATORIES

L. A. ROGERS, *in charge*

Investigations that are important both in the production of milk and in the manufacture of products from milk have been carried on during the year. Among the most important are the following: The nutrition of dairy

cows, bacteriology and chemistry of milk, and investigations relating to the manufacture of cheese, ice cream, condensed and evaporated milk, dry milk, and by-products.

#### THE NUTRITION OF DAIRY COWS

In attempting to determine the reasons for the greater assimilation of the calcium in alfalfa hay than of that in such materials as bone meal and ground limestone, the organic acids of alfalfa have been found to include considerable amounts of citric acid and also some malic and melonic acid.

In the study of the transfer of amino acid through the blood, results have been obtained indicating that the blood contains little free cystine, but that it has a good deal of cystine combined with glutamic acid in the form of glutathione. In the passage through the mammary gland glutathione is evidently rapidly removed from the blood.

The results of an extensive investigation of the relative merits of methods of estimating the energy values of feeds for dairy cows show very definitely that the metabolizable energy value constitutes an accurate index of the relative value of feeds for maintaining nutritive equilibrium, whereas their net energy values are less accurate.

#### BACTERIOLOGY AND CHEMISTRY OF MILK

The proteolytic bacteria of milk have been grouped on the basis of their action on amino acids and other simple nitrogenous substances. Work is in progress on the mechanism of protein decomposition by bacteria. Incidental to this work a method has been perfected for the rapid determination of the action of liquefying bacteria on gelatin, a characteristic extensively used for the differentiation of bacteria.

Results have been obtained throwing some light on the bacteriology of the lactic fermentation. The relative rate of multiplication and of acid formation, as well as some of the factors which determine the final number of bacteria, has been ascertained.

Considerable data have been collected showing the effect of the age of a culture when it is inoculated into milk on the subsequent rate and type of growth. This affects not only the time required for rapid multiplication to begin, but also the type of cell which develops. This work has a direct ap-

plication in the use of starters in cheese making to control abnormal flavors.

In work on grading milk for quality a number of reduction indicators have been used in comparison with methylene blue. One of these has given promising results in that its reaction is much more rapid than methylene blue and gives a characteristic reaction for milk affected by the sweet-curdling bacteria.

#### CHEESE

Much attention has been given to the reaction of the *bulgaricus* cultures under the conditions in which they must grow in cheese. This is important since the control of abnormal fermentations, which are the immediate cause of the greater part of the inferior cheese, is largely a matter of developing the acid-forming bacteria so that they will be in an actively growing stage at the time the abnormal fermentations begin. If a very young starter is used, growth will start in the kettle before the cooking temperature is reached, and while growth is checked by the high temperature the effect of a mass inoculation is obtained. A method has been perfected of measuring the rate of development of both starter and fermentative organisms under conditions simulating those existing in the cheese and in this way determining the most effective starter for controlling abnormal fermentations.

When these results were applied to Swiss cheese making, it was found that a *bulgaricus* starter 12 hours old was much more effective in suppressing gassy fermentations than a 24-hour culture. It was also found that if milk artificially infected with an anaerobic gas former is incubated for a short time to throw the gas-forming organisms into the rapidly growing condition before the milk is heated, the proportion of gassy cheese is much reduced.

The culture cheese has a tendency to develop a dry woody texture, and considerable attention has been given to this defect in the past year. The texture of the cheese, as determined by penetrometer measurements, changes as it ripens, and is affected, to some extent at least, by the acidity of the starter. In the field some improvement in the texture of the culture cheese has been obtained by using a young culture with a low acidity.

The small-scale commercial manufacture of Roquefort cheese at Grove



City, Pa., has been continued. The proportion of second-grade cheese has been reduced to a very small quantity and the demand has been increasing. Under these conditions it has furnished a profitable outlet for milk.

No Parmesan cheeses have been made in the past year, but some of those made previously have ripened satisfactorily. Some information has been obtained on the proper amount of fat to be incorporated and the best method of using the starter.

A number of young Parmesan cheeses have been imported from Italy and have been used for bacteriological studies. A collection of typical cultures has been obtained which will be used in making experimental cheese.

#### ICE CREAM

In a study of the factors which control the physical condition of ice cream, determinations have been made of the temperatures at which crystals of lactose, cane sugar, milk salts, and water separate when ice cream is frozen. This has shown the exact conditions under which the two forms of milk sugar and cane sugar may separate from an ice-cream mix. Results obtained throw some light on the occurrence and nonoccurrence of sandiness in ice cream.

An ice-cream mix evidently has a viscosity which disappears as the mix is whipped, and a basic viscosity which persists. This latter viscosity can be measured, and preliminary results obtained indicate that it is a factor in determining the texture of the finished product.

It has also been shown that the variation in a normal mix is not in the amount of swell which can be obtained, but on the rate at which the maximum is reached. This rate is affected materially by the composition of the mix.

#### CONDENSED AND EVAPORATED MILK

In the past year some results have been obtained in the study of changes which take place in milk when heated at high temperatures. The changes which have been determined include a progressive increase in the calcium-ion and hydrogen-ion concentrations. The increase in hydrogen-ion concentration is a direct function of the time and temperatures of heating and of the lactose concentration. Although positive proof has not yet been obtained it has been shown to be highly probable that the source of the acid-

ity is the decomposition of the lactose.

Some preliminary work has been done on the effect of temperature on the flavor, color, and viscosity of milk, evaporated milk, and cream. This work is being carried on to obtain a guide for the proper sterilization of evaporated milk and, if possible, to develop a method for preparing a sterile cream or unconcentrated milk.

The results already obtained indicate that the time of sterilization is more important than the temperature.

Modified evaporated sterile milk, powdered modified milk, and sour modified milk have been sent to the Army Medical Research Board of the Philippines and some of this is now being used in a native hospital.

#### MILK POWDER

Work has been continued on the factors controlling deterioration of skim-milk powder and an investigation started on the relation of the quality of skim-milk powder to its use in bread making.

Additional results have been obtained showing that the amount of water in the powder is of importance. A certain amount of the oxidation is due to combined oxygen which can not be removed by evacuation or displaced with an inert gas; consequently, milk powder will continue to change but at a slower rate in a vacuum or in a container filled with an inert gas. In this connection carbon dioxide can not be considered an inert gas since the oxidation of the fat proceeds more rapidly in an atmosphere of this gas than in either a vacuum or in the air.

The relative values of storage temperatures between 25° and 0° C. upon the rate of increased susceptibility to oxidation have been determined. With milk powders of low moisture content (1.5 per cent) the numerical value of the rate of susceptibility increase is one-half as great for storage at 3° as it is at 25°.

Clarification of the milk has a marked effect in improving the keeping quality of the powder. This is apparently due to the removal of the enzymes or to some other agency which accelerates the oxidation.

The baking tests have shown that heating to 70° for four hours, or to higher temperatures for shorter periods, increases the viscosity of a solution of the powder and produces a favorable effect on the size and texture of the loaf.

## BY-PRODUCTS

The process of making a concentrated sour milk for chicken feed has been put on a commercial basis and is now extensively used.

It has been shown that by souring whey and skim milk separately, they may be mixed and concentrated, thus making a poultry feed which on account of its high lactose content is especially adapted to combating coccidiosis.

Work is now in progress on the use of concentrated sour skim milk in certain kinds of cooking. Results obtained indicate that it can be used successfully in biscuits, pancakes, and other foods in which sour milk is ordinarily used.

In the course of the investigations on the separation of whey albumin, a method has been developed by which lactose can be separated more quickly, with less expense, and with a greater yield. By this method 90 per cent of the total sugar is recovered without previously separating the proteins from the whey. The crude sugar contains over 90 per cent lactose and is easily purified. Arrangements are being made to develop new uses for milk sugar of somewhat less than the usual purity.

A soluble lactalbumin powder has been obtained possessing the foaming properties of egg albumin, but this preparation lacks some of the properties essential to its successful use in baking and candy making. This work is being actively continued with the hope of correcting this defect.

## DAIRY-CATTLE BREEDING INVESTIGATIONS

R. R. GRAVES, *in charge*

The four major breeding projects described in the previous report were carried on through the year with no unexpected interruption. There was some loss in numbers in the foundation herds, and the succeeding generations of females increased despite an adverse sex ratio during the year. The Oregon Agricultural College was added to the list of cooperating institutions on the continuous use of proved-sires project.

In the linebreeding-outbreeding project the first sire, Denton Colantha Sir Rag Apple, continues an active breeder even though he is past 15 years of age. Eleven of the foundation cows are still living, and there are now 30 females on the first outcross generation. The

second bull on this project has been in service one year and his daughters number 4, with 11 cows pregnant to his service.

In the inbreeding-outbreeding project no notable increases in the first generation were made. This project calls for the mating of the three Jersey bulls to their own daughters.

Of the 12 daughters of the Moose O'Fernwood, 10 have been bred back to their sire. Four foundation cows still remain. Moose has sired one outcross heifer from a Karnak dam; one Karnak daughter and one Torono daughter from a Karnak daughter are bred to him.

Sophie's Torono 23d has 10 daughters in the herd—5 from foundation dams and 5 from the daughters of Hood's Sophie's Tormentor, a sire previously used in this project. Two of these 10 daughters have already freshened but had male calves. Four others are pregnant. On the outcross side this bull has sired one daughter from a Karnak daughter, and one Moose daughter from a Karnak daughter is bred to Torono.

The third group is now headed by Tiddledywink's Raleigh, the successor of Karnak's Noble 4th, deceased. Tiddledywink's Raleigh has 6 daughters, 1 being from a daughter of Karnak. Three are almost of breeding age. Thirteen foundation cows and 6 daughters of the Karnak bull are left in this group. All of these are being bred to Tiddledywink's Raleigh, and out of the 19 cows 6 are now pregnant.

The family-crossing project was advanced during the year by the addition of one 2-family female, two 2-family males, and a 4-family male. The herd has now a total of 8 males and 6 females of distinct 2-family combinations and 1 male and 2 females of the 4-family group.

## DIVISION OF THE BREEDING HERDS

Continued trouble with contagious abortion and the accompanying sterility and breeding troubles, together with an unusually severe outbreak of the disease during the latter part of 1925 and the first few months of 1926, led to the decision to separate the breeding herds into two groups, basing the selection on the previous breeding records and the results of the last two agglutination blood tests. All cows and heifers with positive blood reactions on either of the last two tests, together with those animals whose past breeding history made them appear as a menace to the



negative herd, were moved to the northern part of the farm. Facilities are being provided there to carry on all activities necessary for continuation of the breeding projects. This separation involved the movement of 61 females in the breeding projects. Twenty-eight of these were foundation animals and 33 were first and second generation offspring.

Calves dropped in the positive herd will be reared with the clean herd. The plan is to maintain the negative herd free from abortion disease and continue to breed the animals in the positive herd as long as they will bear calves. It is the belief that the virulence of the disease in this herd will gradually subside through the lack of fresh material on which to renew its vigor.

Although this may appear a radical step, there was justification for it in the fact that other measures taken to control this disease had brought no permanent results, and the progress achieved in the breeding work under existing conditions would be unsatisfactory. With normal breeding efficiency in the clean herd of 69 females and such contribution in offspring as may be made by the positive group, it is anticipated that the new arrangement will result in a far more rapid expansion of the generations of offspring in the various projects and an earlier arrival at an interpretation of results which depend to a large extent on adequate numbers.

The work of herd division was greatly facilitated by the services of the veterinarian added to the staff during the past year.

#### FEEDING SPROUTED OATS AND WHEAT GERM

Uncertain breeding, delayed conception, and temporary sterility among dairy cows and heifers are causing economic loss and grave concern to the dairy farmers and breeders of dairy cattle. A somewhat similar condition among white rats was reported by Evans to be due to a nutritional deficiency, or shortage of the so-called vitamin E in the diet. To determine whether or not the above condition in dairy animals was caused by a shortage of this vitamin in the ration, it was deemed advisable to feed certain shy-breeding animals on fairly large quantities of sprouted oats and others on wheat germ, as these two feeds have been reported to contain the vitamin in abundance.

The effect of feeding sprouted oats was tested on a few animals during

1923 with results that warranted a more extensive trial, and during the past year provision was made for sprouting oats in large quantities. Ten animals have been pronounced pregnant after receiving the sprouted oats for periods varying from 10 to 114 days. Five of these animals were cows of 5 years of age or older, and 5 were heifers being bred, 4 for first and 1 for second pregnancy. The older animals had each been bred from 5 to 17 times before oats feeding was begun. After the oats feeding, conception occurred in 2 cases at first service, in 2 at second service, and in 1 at the third service. The intervals between the dates of first feeding and successful service range from 19 to 71 days with an average of 45 days. The heifer group shows more variability, and none of the animals had been served more than 4 times before the feeding was started. One heifer had aborted previously but conceived at the first service 15 days after the first oats feeding. One heifer had shown no signs of heat up to 18 months of age. She came in season 10 days after the oats feeding was started and is now pregnant at the fifth service, which occurred after 113 days of oats feeding. The other 3 were heifers that failed to conceive on 3 and 4 trials, but were successfully bred after 1 to 5 services following the oats feeding, conception occurring after 10 to 114 days.

The completed data on the feeding of wheat germ are meager, but one heifer, bred unsuccessfully three times, is now pregnant at the fifth service after the feeding began. The period was 123 days.

Other animals are now receiving these two feeds, and heifers are being fed sprouted oats in advance of first breeding to determine whether this practice will reduce the average number of services per initial conception.

#### FERTILITY OF BULLS

The plans of the various breeding projects call for the use of proved bulls. This requires that the animals selected continue in active service longer than the period of life of the average dairy bull. Because of the limited number of bulls which are known to be prepotent for high production it is desirable that their period of usefulness be prolonged to the utmost. For these reasons it is valuable to know the best manner of handling service bulls to sustain their vigor. The feeding of sprouted oats and systematic exercise have been



added to the daily régime of the bulls at Beltsville, Md. The average age of the five-herd bulls there is 10½ years, and all are over 8 years.

Several young bulls are being fed experimentally to test the effect of rations on fertility, and two older bulls are now being examined to find what results follow excessive service, lack of exercise, and close confinement.

#### PHOTOGRAPHY AND OFFICIAL TESTING

These two activities are part of the routine work of the breeding projects, as the plans call for photographs at regular intervals and two official tests on each cow, one as a heifer and one after mature age is reached. Two hundred and fifty-four photographs of animals in the breeding herd were taken during the year. These were all heifers, cows, and bulls 1 year of age or older.

Fourteen Jerseys completed Register of Merit records, and their average production was 10,359 pounds milk and 570 pounds butterfat at an average age of 4 years 5 months. Six of these 14 are first-lactation heifers. To date 51 Jersey cows have made 64 yearly records, averaging 9,742 pounds milk and 540 pounds butterfat, their average age being 3 years 10 months.

Ten Holstein cows and heifers completed Advanced Registry tests during the year, averaging 14,208 pounds milk, and 493 pounds butterfat. Eight of the ten were first-calf heifers, all daughters of Denton Colantha Sir Rag Apple. This raises the total number of Holstein records to 67, made by 49 cows, and averaging 16,626 pounds milk and 570 pounds butterfat.

Fourteen of the Beltsville-bred daughters of Denton Colantha Sir Rag Apple have now made records averaging 13,761 pounds milk and 477 pounds butterfat at 2 years 3 months of age.

#### PROVED BULLS

The male calves dropped in the herd at Beltsville are being lent to dairy farmers near by in order to prove their ability to transmit milk and butterfat production by testing their daughters. The importance of this work is growing as proved bulls are hard to find, and evidence gathered from our studies of past breeding operations indicates that rapid and continued improvement in producing ability follows the use of bulls that are able to transmit this ability.

#### BIOMETRICAL STUDIES

Monthly weights of Jersey and Holstein heifers recorded at Beltsville for a period of two years following birth were analyzed.

It was found that in general increase of weight could be approximated by a semilogarithmic curve. A divergence between observed weights and those given by the curve prior to the age of 6 months was considered significant, since skim milk was included in the ration for only six months. When the gains were plotted, it became evident that the rate increased until about the sixth month of age and then declined, indicating the existence of an extrauterine growth cycle.

When the heifers were grouped according to their sires it was learned that no actual relationship existed between the birth weights and subsequent monthly weights. For instance, an average weight of only 43.6 pounds at birth was recorded for the daughters of the Jersey bull, Merton's Gamboge, and their weights continued to be the lightest of any of the daughter groups for every month following. In contrast, the daughters of Hood's Sophie's Tormentor, also having a light average at birth, 47 pounds, after the age of 6 months reached weights comparing favorably with those of the heaviest group, that of the daughters of The Moose O'Fernwood, weighing 62.6 pounds at birth.

#### A STUDY OF THE RELATION OF THE CONFORMATION AND ANATOMY OF THE DAIRY COW TO HER MILK AND BUTTERFAT-PRODUCING CAPACITY

##### THE MEASUREMENT OF TYPE

The translation of type to numerical values has been continued. Several new items have been added to make the measurement of conformation more nearly complete. Since the work was commenced, 248 sets of measurements on heifers under 18 months of age and 133 sets on cows have been completed. Of these, 99 sets on 58 growing heifers and 31 sets on cows have been added during the year. These are being analyzed. Body surface area, barrel volume, slope of rump, spring of ribs, degree of wedge shape, and many other factors are being determined. The contours or cross-section outlines of the chest and paunch are proving particularly instructive. Two contours have been drawn for each set of measurements.

The data obtained also include notation of the handling quality and the actual measured thickness of the hide. As a special test 22 cows at the Huntley, Mont., farm were compared with 30 cows in the Imperial Valley of California during the early winter months to get an idea of the effect of climate and temperature on hide condition. Data on the California cows were taken by the University of California. During the year 426 comparable photographs of 105 different animals have been taken for the purpose of permanently recording the type of developing animals. Photographs are taken against a cross-lined background. They have revealed additional cases of sudden and unexplained changes in conformation.

#### THE UDDER-MAMMARY GLAND STUDIES

During the year 163 sets of observations have been recorded on 47 heifer calves. The first observation is recorded at 10 to 14 days of age. Great external and internal variations are in evidence at ages as early as 3 to 6 months. The four quarters are entirely distinct in the early stages. The stages of development are definite, but are more advanced in some individuals than in others.

In the past year 237 sets of observations of more than 30 different items have been recorded on 44 lactating cows. Including those previously taken, a total of almost 3,000 different sets of examinations is available. A system has been developed for translating descriptive terms into numerical values to make tabulation and analysis possible. Progress is being made in the tabulation and analysis of these data. In addition to these observations, 25 sets of four different views of udders, photographed in the third month of lactation, have been added during the year.

The method of removing the udder from a cow at the time of slaughter, filling it with formaldehyde, freezing, and cutting it into sections for gross anatomy studies was described in last year's report. Previous to this year, four udders were treated in this manner. Five additional udders have now been prepared and sectioned. One was that of a nonbreeding Jersey heifer, 2½ years old. It showed very satisfactorily the structure of an immature gland and the manner in which the gland develops. The udder of one mature Holstein was sectioned because during the entire lactation period it persistently showed an un-

usually hard, harsh, coarse, and fibrous type of tissue which changed little at any time in volume or general condition. Splendid photographs of the sections were obtained. The udder of a mature grade, Holstein was removed in the usual manner; but instead of using untreated formaldehyde in all quarters, the right front and left rear quarters were filled with formaldehyde containing a water-soluble stain. After being frozen the udder was cut into horizontal, transverse sections. The completeness of the separation of all four quarters was clearly shown. In two other cases, the right half of the udder was filled with formaldehyde in the usual manner, after which the left half was removed by cutting just to the left of the septum. Only the right half was sectioned. The left half was removed in order that it might be delivered to the histologist in a fresh condition.

An histological analysis is now being made of the tissue of the mammary glands sectioned. One of the lateral halves of the udder is used for gross anatomy studies. The other half is laid off into definitely located areas from which sections are taken by the histologist. Eventually, a complete record of the development, the activity, the gross make-up, and the microscopic structure of the gland will be available to be compared with the breeding and the producing capacity of the cow.

(a) Some preliminary work has been performed to determine the fluid carrying capacity of mammary tissue from different locations in the same udder and from udders of varying type and structure. Some idea of the spongy character of udder tissue can be had from the following preliminary tests on three udders:

No. 245 was a fibrous, fleshy type of udder removed less than two months after calving, handled in the usual manner, and the gross sections stored in a refrigerator for approximately 11 months, until they were almost dry. No. 243 also was a fibrous, fleshy type of udder but nonlactating. The tissue had been stored in a refrigerator only a few days. No. 459 was a loose, soft, mellow, lactating udder. The tissue had been stored in a refrigerator for five weeks.

Blocks of tissue 2¼ inches square and ¾ inch thick, taken from different parts of each udder, were immersed in water until saturated. When removed the excess water was blotted from the surface. The blocks



were then weighed and subjected to 50 pounds pressure per square inch. Immediately after pressure was removed they were weighed again and reimmersed in water to determine the proportion of the expressed water they would recover. The pressure reduced their weight from 100 per cent to 44, 60, and 67 per cent, respectively. Immersion raised the weight to 88, 94, and 100 per cent, respectively, for the three udders.

(b) Opinions differ widely concerning the internal capacity of the mammary gland. The quantity of formaldehyde injected into the udder through the teats has been measured in recent tests and has been found greatly in excess of that generally supposed. The first three of these udders were of the fleshy, hard, fibrous type. The third was nonlactating. The fourth was unusually loose and yielding. The first accommodated 3 to 3½ gallons, the second 13½ quarts, the third 5 quarts in the two right quarters, and the fourth 6½ quarts in the two right quarters. It appears that an internal udder capacity of 3 to 3½ gallons is not at all uncommon.

(c) In an effort to determine whether milk is secreted continuously or chiefly during the process of milking, a Jersey cow producing 12 pounds in one milking daily was killed 24 hours after milking. The udder was removed immediately and suspended by the surrounding hide from an iron frame. The milk was then drawn into a bucket in the usual manner and with approximately the usual ease and rapidity of milking. The quantity of milk obtained immediately was 9.2 pounds. Four hours later 1.07 pounds additional was obtained. A total of 10.27 pounds, therefore, was milked from the udder after all circulation and other body connections had been severed. Samples of the two milkings before death and the two milkings after death were taken for analysis.

#### THE RELATION OF EXTERNAL FORM TO INTERNAL ANATOMY

Analysis of the data on packing-house animals has progressed satisfactorily within the year. At present 90 complete correlation coefficients are available. Of these, 33 are considerations of heart weight, 32 of lung weight, 8 of intestine length, and 17 are miscellaneous. When the weight of heart and the weight of lungs are correlated with the same body measurements or organ weights, the correlation coefficients are similar except that in all but 6 instances the co-

efficients for lung weight are lower than for heart weight. Of these 6 cases, 4 are correlations with other organ weights, 1 is with the body length from withers to hips, and 1 is calculated value for volume of barrel which is based on the body length above mentioned. It appears that there is a considerably higher relationship between heart weight than between lung weight and body size or external or internal body measurements. In every instance, whether compared with weight of body, weight of blood, weight of hide, or external or internal body measurements, the correlation of depth of fore chest is strikingly higher than that of width of fore chest.

Although only a small number of correlations have so far been determined for length of intestines, that measurement does not seem to bear any close relationship to any of the body measurements, body weight, or body surface area. The only distinctly significant correlation yet shown is that between the length of intestines and weight of intestines.

#### THE RELATION OF EXTERNAL FORM AND INTERNAL ANATOMY TO PRODUCING CAPACITY

The ante-mortem and post-mortem studies of cows of known producing capacity have been continued. Complete reports on 14 cows have been added to those previously reported from the herd at Beltsville, Md.

A number of side experiments are being conducted on animals so handled. For example, a test was recently conducted to determine the length of time required for feed to pass through the cow and be eliminated. Whole corn and oats made their first appearance in the feces after periods varying from 15 to 20 hours from feeding. This will be of interest in connection with the length of intestines.

Eleven State experiment stations are now cooperating in the ante-mortem and post-mortem studies. Three of these were added this year. Twenty-nine complete reports have been received from these stations during the past year. Of these, the Pennsylvania State College has contributed 11, and Cornell University 8. Demonstrations were conducted at 10 of the stations to illustrate the exact methods of study.

The extreme variation in some of the items is interesting. Two cows slaughtered at the Pennsylvania State



College were of the same breed, within 36 pounds of the same weight, within 1 centimeter of the same depth of paunch, and within 3 centimeters of the same circumference of paunch; yet one had 129 feet of intestine length whereas the other had 212 feet. The greatest length of intestines yet recorded is 244 feet.

The total number of cows of known production on which both ante-mortem and post-mortem reports have been assembled to date is 82. Twenty-nine of these have been prepared at Beltsville. The remainder have been submitted by 8 of the 11 cooperators.

#### RUMP STUDIES

The significance of the slope or angle of inclination of the pelvis is being studied in relation to inheritance, shape, and position of udder, breeding difficulties, size of offspring, and other factors. Striking changes in slope of rump of dairy animals have been noted. The fundamental causes are being sought through a study of the assembly and mechanics of the pelvic bones. The complete pelvis of a young cow has been removed and prepared for this purpose.

Cooperative work is being carried on with the University of Wisconsin and the University of Missouri to determine the significance of the slope of the rump in relation to inheritance and in relation to shape and position of the udder.

#### FIELD STATIONS

The Holstein herd at Ardmore, S. Dak., now numbers 18 females, and during the past year 4 first-calf heifers finished official tests averaging 14,710 pounds milk and 460 pounds butterfat.

Figures compiled on the cost of raising 21 dairy heifers to the age of 2 years show an average feed cost of \$72.07. These data cover a period of almost 3 years, and by analysis the average cost of raising the first 4 heifers was found to be \$51.81 and the last 4, \$97.23.

At the Huntley, Mont., station the Holstein herd has grown to 45 females. Nine cows and heifers finished Advanced Registry tests during the past year, the average being 16,008 pounds milk and 545 pounds butterfat. This makes a total of 51 records completed at this station to date, which average 14,850 pounds milk and 513 pounds butterfat.

The comparison of three planes of feeding dairy cows, namely, full grain

ration, limited grain, and roughage only, and also the determinations of the carrying capacity of irrigated pastures, were continued.

At the Woodward, Okla., station the Holstein herd now numbers 25 females. During the past year eight 2-year-old heifers and one cow were officially tested, and their records average 13,977 pounds milk and 458 pounds butterfat, which brings the total number of tested cows to 22.

Dry-land pasture experiments are being conducted with this herd.

Forty-two Jersey females are now in the dairy herd at Jeanerette, La. Four Register of Merit records, including those of three first-calf heifers, were completed last year, with an average of 8,738 pounds milk and 457 pounds butterfat. The total number of official records to date is 26, with milk averaging 7,627 pounds and butterfat 406 pounds.

Bull calves are being lent from all the station herds in order that their transmitting ability may be properly determined.

#### MARKET-MILK INVESTIGATIONS

ERNEST KELLY, *in charge*

Market-milk investigations include studies of problems in dairy sanitation, milk-plant management, market milk and cream, and other factors in the production and preparation of market milk and cream.

#### DAIRY SANITATION

A study was made of the Pasteurization requirements and the amounts of Pasteurized milk and various inspection methods in different cities in the United States. The data were compiled and disseminated through the milk inspector letters.

City milk ordinances were received from 250 cities, and a compilation and digest of the important features of these ordinances have been made.

Compilations were made from data obtained at Grove City on the influence of weather and cooling on the quality of milk as determined by the methylene blue reduction test. These data indicate that surface coolers were a help in improving the quality of milk.

An investigation was made to ascertain which rapid tests are being used in milk plants and factories to determine the quality of milk and also to ascertain what satisfaction they were giving. Out of 287 cities, 44.6 per cent used some rapid tests. In 77.1 per

cent of the commercial milk plants and milk-product factories rapid tests were used. The methylene blue, sediment, acidity, and direct microscopic were the leading tests.

A number of tests were made to determine the amount of steam required to operate three sterilizing cabinets constructed of concrete, wood, and galvanized iron. The various runs with each type of sterilizer were very uniform. The amount of steam required to operate the wooden and galvanized iron cabinets was approximately the same.

To operate the concrete sterilizer, however, required almost two and one-half times as much steam as for the other two types, if the subsequent drying process is not considered, and twice as much when drying coils were used for one-half hour after sterilization. There was little difference in the efficiency of the cabinets in drying utensils, but the galvanized-iron cabinet seemed to be a little more efficient in this respect, with the wooden and concrete sterilizers following in the order given.

Fly eradication and control work in cooperation with the Bureau of Entomology has been continued at the Beltsville dairy. The premises were kept as free as possible from accumulations of manure. Flytraps like those described in Farmers' Bulletin 734 were set as soon as the first flies appeared. They were baited with blackstrap molasses from sugar cane diluted with 3 or 4 parts of water. The bait was renewed once a week and the traps emptied when the accumulation of dead flies was so great as to reduce seriously the light under the trap. During the season the 10 traps used caught 86 gallons, or approximately a half billion flies. The milk room was practically free from flies throughout the whole season.

In order to protect the cattle as much as possible from horn and stable flies, a spray of kerosene extract of pyrethrum was used. This killed the flies rather than merely repelling them. Partially opened dried pyrethrum flowers were procured and soaked for 48 hours in kerosene. They were used at the rate of 1 pound of flowers to 2 gallons of kerosene. The cost of the spray was 35 to 40 cents per gallon.

To apply this extract an air-pressure sprayer was used which held about 1 gallon and could easily be operated with one hand. In spraying for horn flies an attempt was made to catch them in a cloud of the vapor as they swarmed up after the first

spray struck them, and this was very effective. In applying this extract a nozzle which will produce a very fine spray was used.

In spraying for stable flies, which are in most cases found sucking blood from the cows' legs, the spray was shot directly on them, usually with telling effect. Since the major part of the spray is kerosene, care was taken not to cover the cattle with it unnecessarily, and they were not curried or brushed or turned out in the hot sun immediately after being sprayed. By observing these precautions no trouble was experienced from blistering.

Although in both seasons the horn flies had appeared in considerable numbers before the spray was used, their numbers were appreciably reduced after a week of daily spraying, and they were easily kept under control the rest of the season.

Investigations in cleaning and sterilizing milking machines were completed during the year. Comparative tests were made on variations of the heat method of sterilizing and on the length of life of the rubber parts.

The units were heated in water at a temperature of 160° to 165° F. for 20 to 45 minutes, at the end of which time they were placed either (1) in a refrigerator, (2) in weak chlorine solution (about 1 to 20,000 available chlorine), or (3) in a warm room. A check unit was allowed to remain in hot water between milkings. Some tests were also made with a lower sterilizing temperature of 145° to 150° F., the units remaining in the water between milkings. The above methods showed that milk from the units placed in a refrigerator between milkings averaged 3,100 bacteria per cubic centimeter; from those placed in a weak solution of chlorine between milkings it averaged 2,200 bacteria per cubic centimeter; from those placed in a warm room between milkings it averaged 5,540 bacteria per cubic centimeter; from those heated to 145° to 150° F. and remaining in hot water between milkings it averaged 11,930 bacteria per cubic centimeter; and from the units sterilized in hot water at 160° to 165° F. and remaining in the water between milkings it averaged 2,570 bacteria per cubic centimeter.

The teat-cup liners were the first rubber parts to wear out, the tubing outlasting them considerably. When the units were sterilized at 160° to 167° F. and allowed to remain in the water between milkings, the teat-cup



liners lasted from 176 to 188 milkings. When the water was only 145° to 150° the liners lasted 218 milkings, while those that were left only 20 to 35 minutes in the hot water (160° to 167°) and then placed in a cold-storage room lasted 315 milkings.

Tests were also made on units sterilized in a saturated brine solution with added chlorine to make 1 to 5,000 parts of available chlorine. The teat-cup liners were used for 537 milkings on 267 days and were still in good condition at the conclusion of the work.

### MILK-PLANT MANAGEMENT

The milk-plant labor studies have been continued and the following conclusions drawn:

1. Increased costs of material and labor have made it necessary for milk plants as well as other establishments to study plant costs and to try to increase the efficiency of plant operations.

2. There are great variations in the man-hour requirements for various milk-plant operations due to the arrangement of the plant and the equipment.

3. In receiving the milk at the plant, much better results were obtained as to labor required where the milk was dumped at a point close to the receiving-room door, or where a well-arranged conveyor system was used, than where the milk was transferred to the dump tank by trucks or by rolling the cans.

4. Much of the labor in receiving milk from cars "spotted" beside the plant could be reduced by well-arranged conveyor systems.

5. In checking in the routes a large amount of time and labor is saved by using conveyors direct to the bottle washers instead of stacking the bottles between the checking-in platform and the bottle washers.

6. The use of trucks in checking in the routes is not so efficient as the use of conveyors in regard to time and labor required.

7. At small plants labor in checking the routes may be saved by having the bottle washer close to the point where the routes are checked in.

8. The washing and filling of the bottles required the most labor of any of the operations in the plant.

9. At 68 plants using the direct system of washing and filling the bottles 586.8 bottles were washed and filled per man-hour, whereas at 97 plants us-

ing the indirect system only 370 were washed and filled per man-hour.

10. The average number of man-hours required to wash and fill 1,000 bottles was 1.83 at plants using one floor level for those operations and 2.19 at plants using more than one floor level.

11. For Pasteurizing and cooling the milk, large plants generally used less labor per gallon handled than small plants. However, much more labor was used for cleaning the Pasteurizing department in the large plants than in the small plants, so that when the labor for cleaning was included the number of gallons Pasteurized and cooled per man-hour was not so much greater in the large plants than in the small ones.

12. In checking out the routes large dealers must use a system that will permit a great number of routes to be checked out per hour regardless of the amount of labor required.

13. Best results as to time required to check out the routes at large plants are obtained by loading from several points or through three or more doors or chutes direct from the storage room.

14. When only man-hours of labor required per route checked out are considered, loading out from one door or chute direct from the storage room was the most efficient system. Of course, this is adapted only to small plants.

15. As a general rule fewer men are required at plants of one or two stories than at plants of several stories. This is especially true in the case of medium or small plants.

### MARKET MILK AND CREAM

#### CREAMING OF MILK

Work was conducted to ascertain the influence of transportation on the creaming of milk. Nearly 300 samples of milk were taken to determine whether the transportation in trucks of milk cooled or shipped warm, in full or partly filled cans, influenced the creaming. These data indicated that the cream line is slightly increased in cooled milk transported in partly filled cans over a distance of 16 miles. This seems to show that the agitation of the partially filled cans for this distance prevented somewhat the rising of cream so that the milk was not subjected to a severe recreaming, which has a detrimental effect on the cream line.



## VISCOSITY

Laboratory studies of the viscosity of cream have been continued, and special apparatus has been procured to measure the size of the fat globules. In addition to those reported last year, the following conclusions may be drawn:

1. Determining the viscosity does not affect the viscosity of cream; that is, using the same cream for a series of determinations gives the same results as if fresh cream were used for each determination.

2. Increasing the acidity to 0.3 per cent increases to a very slight degree the viscosity of cream. The increase in viscosity is slightly more marked at a low temperature (5° C.) than at a higher one (62.5°).

In addition, much work has been done on the size and appearance of fat globules in relation to the viscosity of cream. This work indicates:

(1) Fat globules range in size from 1 to 10 microns.

(2) The average size of fat globules in centrifugally separated cream from mixed milk produced by Jersey, Guernsey, and Holstein cows, is 3.05 microns.

(3) The clumping or grouping of fat globules has a greater effect on the viscosity of cream than does the size of fat globules.

(4) The clumping or grouping of fat globules takes place more rapidly in cream with a high butterfat content than in cream with a low butterfat content.

(5) Very little clumping takes place in cream with a butterfat content of 20 per cent prior to 48 hours.

## FLAVOR AND ODOR

Work has been concluded on the effect of dried beet pulp, green oats and peas, pumpkins, carrots, and sugar beets on the flavor and odor of milk. None of these feeds seem to have a pronouncedly bad effect. The samples of milk from the cows fed beet pulp were aged for four days at 10° C. and did not develop abnormal flavors or odors to any greater extent than did check samples held under similar conditions.

A study was made in Mississippi of the effects of bitter weed on the flavor and odor of milk. It was found that cows did not consume bitter weed if the pasture was good. It is reported that in hot, dry spells the only green feed found in pastures is bitter weed, which the cows will then eat. It is

estimated that at such times they consume not less than 15 to 20 pounds of this feed each day.

In the feeding experiments it was necessary practically to starve the cows before they would consume the bitter weed. When 5 pounds were fed 1 hour before milking, very slightly bitter milk was produced. When cows were fed for 4 or 5 days on 5 pounds of bitter weed a day, 4½ pounds consumed 1 hour before milking produced slightly bitter milk. When cows consumed from 6 to 7 pounds 1 hour before milking, the bitter taste was more pronounced. It took more than 7 pounds fed 1 hour before milking to produce really bitter milk and over 9 pounds to produce very bitter milk. Five pounds fed 12 hours before milking gave only a trace of the bitter flavor. When 10 pounds were fed 12 hours before milking, bitter milk was produced and this flavor did not disappear for about 27 hours after the weed was eaten. No objectionable odor seemed to be associated with the bitter flavor in milk.

The flavor caused by this weed was more pronounced in skim milk than in whole milk and much less pronounced in cream than in the milk.

Drying the bitter weed did not decrease its effect on the milk.

The first milk drawn from a cow is the most bitter. This coincides with the fact that the bitter taste seems to be associated more with the milk serum and less with the butterfat.

## FOAMING

Results from the experiments on foaming indicate that the Pasteurization time and temperature employed play but a small part in the foaming of milk and cream.

Experiments carried on in cooperation with the Minnesota State Department of Health showed that the amount of foam on Pasteurizers varied from a very small amount to layers 8 to 12 inches thick. It varied in character from a light, airy foam to a yellow, heavy, compact, greasy layer.

From the standpoint of destroying bacteria, Pasteurization by the batch method was not so effective for foam as for milk. The foam on Pasteurized milk had a higher count than the milk itself, possibly because the temperature of foam on Pasteurizers was lower than that of the milk.

The butterfat content of foam on Pasteurized milk was higher than that of the milk and showed great variations. There was also a variation in

the number of bacteria in foam sampled at different places in the vat. Increases in numbers of bacteria in the foam were observed during the holding period.

### DAIRY INTRODUCTION

J. H. McCLAIN, *in charge*

Dairy introduction consists of three main lines: Dairy-herd improvement, milk utilization, and dairy manufacturing. Under dairy-herd improvement, economical production is emphasized through the work on cow-testing associations, bull associations, purebred-sire campaigns, and improved feeding methods. Under dairy manufacturing, improved methods that have been successful in the laboratory investigations and also at the Grove City creamery are introduced into the factories in the States to assist creameries, cheese factories, and other plants in making better dairy products. Milk-utilization work is carried on in cooperation with the State agricultural colleges by means of city and county milk-for-health campaigns.

### DAIRY-HERD IMPROVEMENT

On January 1, 1926, there were 777 cow-testing associations in active operation in the United States. The yearly individual cow record strips are now being received from about 500 of these associations. As there are on an average between 400 and 500 cows on test in each of these associations, the number of individual cow records received in a year is more than 200,000.

Herd and association summaries from the records of each association are being made and copies of these tabulations returned to the States from which the records came. These summaries are completed and returned within a month, often within two weeks, after the records are received. This enables the State specialists to get this information to the members of the cow-testing association at a time when it will do the most good. In connection with these summaries attention is called to lessons that may be learned from these tabulations and to conclusions that may be drawn from them.

In addition to herd and association summaries, the following summaries are made: Relation of butterfat production to other factors; relation of milk production to other factors; relation of cost of concentrates to other

factors; influence of season of freshening on production and income; and comparison of purebreds, grades, and scrubs.

Comparisons of the records of dams and daughters have been continued. Not only does cow-testing association work test the cows but it also proves the sires by testing the daughters of each sire and by comparing the records of all the daughters of the bull with the records of their dams. About 150 sires in cow-testing associations have already been proved. Only about one-fourth of these sires have made a marked improvement in their offspring when compared with the dams.

A further investigation has shown that about four-fifths of the sires had been sent to the butcher before the records of the daughters were available. This fact has demonstrated that some way should be devised by which all the well-bred sires may be saved until the daughters have been tested for production.

In connection with the testing of the daughters of purebred bulls the cow-testing associations are furnishing results regarding dairy-herd improvement due to bull associations. So far as these records have been tabulated, the daughters of bull-association bulls have produced about 15 per cent more than the dams of the daughters.

### COW-TESTING ASSOCIATION METHODS

Close cooperation has been maintained between the bureau and the committee on cow-testing associations of the American Dairy Science Association. Conferences have been held with the dairy specialists, dairy professors, and extension directors to study the application of the tentative standard rules for cow-testing-association operation drawn up by the committee in the various States, to study the various short-cut testing associations, to create interest in obtaining more complete data on the tabulation strips furnished this bureau, and to maintain a proper distribution of the cow-testing association forms. In the States having a majority of the associations these rules have now been put into effect practically in their entirety, and in most of the others they are gradually being put into practice.

In the furtherance of this work conferences have been held in 26 States and in Canada.

A cow-testing association news letter is prepared and mimeographed each month for distribution to a



mailing list composed of dairy extension specialists, directors of extension, deans of agriculture, and professors of dairying.

The better dairy sires project includes the work on scrub-bull-eradication campaigns and bull associations. Assistance has been given to the extension service of the agricultural colleges in three States in organizing and directing county-wide scrub-bull-eradication campaigns. Each of these served as a demonstration of organization methods.

The results of another campaign that was conducted in the South in 1924 indicate very clearly what may be expected of a properly organized and well-conducted campaign. A survey made prior to the campaign showed that the cows on 71 per cent of the farms were being bred to grade bulls. In September, 1925, one year after the campaign, only one community was found where scrub bulls were being used.

In one of the campaigns 6 purebred bulls were placed during the week of the campaign, and 16 additional bulls have been placed since the campaign proper closed.

The field work in one State was to assist the organization of the counties that had entered the state-wide better sire campaign. In order to stimulate more interest in this work, a contest feature for the district agents and the county agents has been incorporated in the plans for the campaign.

To date nine county-wide organizations have been perfected in the western section and three in the eastern section of the State. At the present time 32 purebred dairy bulls have been placed.

An investigational study has been started of the better dairy-sire work that is being conducted in the different States. Conferences have been held with the dairy specialists, dairy professors, and extension directors, to study their methods of procedure, organization, and methods of follow-up, and to discuss with them the better dairy-sire work as it is handled by this bureau.

Some attention has been given in studying results of bull association operation and organization. Follow-up assistance on this project was given in five States. The annual directory of bull associations in operation January 1, 1926, was published. This showed a total of 225 associations of three or more blocks, a slight

increase over 1925, with a total of 43,853 cows and 1,000 bulls in these associations.

#### DAIRY-HERD RECORDS

On August 1, 1925, in cooperation with the Bureau of Agricultural Economics and the College of Agriculture, Virginia Polytechnic Institute, work was started to obtain dairy-herd records on approximately 35 farms in the Shenandoah Valley of Virginia.

#### MILK UTILIZATION

During the past year the two members of this office who handle the milk-utilization project have directed county-wide milk-for-health campaigns and follow-up work, in cooperation with the extension service of the agricultural colleges of the States. The results of these campaigns invariably show that undernourishment among children decreases as their milk consumption increases.

#### DAIRY MANUFACTURING

##### BUTTER AND CREAMERY WORK

A study is being made to determine the amount of acidity in the cream at which the deleterious effect on the butter, especially the keeping quality, is observed. Churnings have been made of cream with acidities from 0.13 to 0.31 per cent and of cream in which the acidity was reduced from 0.45 to 0.25 per cent. Samples of 135 churnings are now in storage at 32° and at 0° F. These were scored when fresh and will be rescored after being in storage for several months. A sample of each churning was analyzed for butterfat, water, and salt.

Demonstration work in proper methods of creamery operation has been conducted in five States. Monthly or bimonthly butter scorings with analyses of the butter have been held in each State. At these scorings creamery men and butter makers compared butter from various creameries and discussed with the specialist methods of improving the quality and controlling the composition of their product.

The cream of each patron was systematically scored at several creameries. These creameries paid a premium over their base price for high-scoring cream, and all report an improvement in the average quality of cream received.



## AMERICAN AND SWISS CHEESE

The American cheese factories in Tennessee and North Carolina continued their development and received assistance with problems of factory operation.

The introduction of the culture method of making Swiss cheese in Wisconsin and Ohio has been continued in cooperation with the universities of those States and, upon request, a similar project was begun in New York State. Where the new method has been used an improvement in the market quality of the cheese has been noted.

## CONCENTRATED SOUR SKIM MILK

A project begun this year is that of demonstrating a method developed in the laboratories of the bureau, of making concentrated sour skim milk. Six factories, located in five States, have been given assistance, and all report excellent results in the manufacture of this product.

## NAVY BUTTER

This bureau supervised the manufacture of 350,552 pounds of sweet cream butter for the Navy Department. This was done at five creameries. Samples from all plants, after 8 to 10 months in cold storage, scored an average of 92.6.

## RENOVATED BUTTER

Inspection of renovated-butter factories was conducted as in previous years. Six factories were in operation and made a total of 2,482,530 pounds of renovated butter, which is less than two-thirds as much as was made during the preceding year.

## WESTERN OFFICE

Dairy development in the 11 Western States, the territory comprising the work of this office, has made rapid progress during the past year. The increase in demand for high-quality products on the principal markets has directed the work of this office to the importance of better quality of milk, butter, and cheese.

## MARKET MILK

The market-milk work has been so thoroughly introduced in the larger cities that they are now conducting the surprise contests almost entirely without assistance from this office. Consequently, this work has thus far

been confined to the smaller cities. Specific milk-improvement projects have been carried on with a few plants that offered unusual opportunities for such demonstrations.

The score card for milk was revised this year and has been used in all city contests. Twenty milk contests were held with a total of 1,211 samples scored.

## CHEESE WORK

Introducing new methods of making cheese, conducting monthly educational scorings, and improving the milk supply for cheese making has been the main work done on this project during the year. Several new cheese factories have been established in Idaho and one in Utah. Much interest has been shown in Pasteurizing milk for Cheddar cheese making.

## BULL ASSOCIATIONS

In cooperation with the extension service of the University of Idaho, investigational work has been continued in the operation and results of bull associations.

The State of Idaho, with its 32 bull associations, offered splendid opportunity for working out some of the problems confronting the organization of these associations. The studies should also determine their value and prove their practicability in the improvement of dairy herds. These investigations will also show why some associations fail and what should be done to keep others from failing. The results of this study should be of far-reaching importance.

## THE BELTSVILLE STATION

T. E. WOODWARD, *Superintendent*

The dairy experiment station at Beltsville, Md., is operated mainly to provide facilities for investigations in nutrition of dairy cows, dairy-cattle breeding, and market-milk production. In connection with the management of the general herd and the cropping system, however, many practical problems are worked out.

## ALTERNATE HEAVY AND LIGHT FEEDING

The objects of this experiment were to determine any marked difference in the efficiency of utilization of nutrients if they were first converted into body tissue and then into milk, or if they went directly into the formation of

milk. This has an important practical application in the matter of allowing animals to become fat before calving. It is also important to know whether it is necessary to supply the cow's daily needs for nutrients each day or whether a considerable fluctuation from day to day or even from week to week is any serious disadvantage.

Two grade Holsteins were fed alternately by months 6 pounds grain above requirements and 6 pounds grain below requirements, according to the Savage standard. It appears that the two cows fed alternately heavy and light, with a total consumption of 4 and 5 per cent respectively above requirements, behaved about the same as would be expected of cows fed all the time exactly at standard. Consequently, it seems that the conversion of nutrients into body tissue and then into milk was not as economical as conversion into milk directly; but the data from this experiment do not admit of a definite quantitative estimation of the difference.

#### FEEDING GRAIN

An experiment conducted with 11 cows for three months indicates that with an abundance of good roughage, feeding Jerseys at the rate of 1 pound of grain to 3 pounds of milk and Holsteins at the rate of 1 pound of grain to 4 pounds of milk is fairly satisfactory so long as the cow does not yield more than about a pound of butterfat a day. A cow yielding more than this will require a greater proportion of grain to avoid loss in weight and excessive decrease in production. Feeding grain in direct proportion to milk yield is probably about as accurate a system as can be readily put into practice. However, if the cows have all the good roughage they will consume, this will mean that high producers are underfed and low producers are overfed.

#### IMPROVEMENT OF RATION FOR TEST COWS

The grain ration which is now fed to cows on official test at Beltsville consists of 200 pounds ground oats, 100 pounds hominy feed, 100 pounds wheat bran, 75 pounds cottonseed meal, 100 pounds gluten feed, and 150 pounds linseed meal. This is fed along with beet pulp, alfalfa hay, and corn silage. From analyses obtained in our laboratories it seems that this ratio is likely to be deficient in one or more of the essential amino acids, particularly lysine. For this reason another ration containing the same nutritive ratio and the same amount of digestible nutrients as the one given above has been prepared to meet this deficiency, and it is now being fed to some of the test cows in comparison with the above ration. The new ration consists of 100 pounds oats, 200 pounds hominy feed, 250 pounds wheat bran, 50 pounds blood meal, 50 pounds peanut oil meal, 50 pounds linseed meal.

#### SWEET CLOVER AS A PASTURE CROP

Two years' results on the value of sweet clover as a pasture crop are now available. In the spring of 1924 a plot of 6.5 acres was divided into equal parts with one half sown to sweet clover and the other half to mixed grass. For the two years the sweet-clover plot furnished pasture to the extent of 1,145 cow days, 95 of which were crab grass, while a yield of 935 cow days was obtained from the grass plot. Each cow day on sweet-clover pasture cost 14.6 cents. Each cow day on mixed-grass pasture cost 18.8 cents.

The experiment is being continued for another two years in order to obtain further information about the cost of the two kinds of pasture, the carrying capacity of each, and the efficiency of each as a milk producer.







DEC 14 1926

EXPERIMENT STATION FILE

## REPORT OF THE ENTOMOLOGIST

UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF ENTOMOLOGY,  
Washington, D. C., August 30, 1926.

SIR: I submit herewith a report of the work of the Bureau of Entomology for the fiscal year ended June 30, 1926.

Respectfully,

L. O. HOWARD,  
*Entomologist and Chief of Bureau.*

Hon. W. M. JARDINE,  
*Secretary of Agriculture.*

### DECIDUOUS-FRUIT INSECT INVESTIGATIONS

Investigations of deciduous-fruit insects have been carried on under the direction of A. L. Quaintance, as in previous years.

#### PEACH INSECTS

Studies of the oriental peach moth have been continued in New Jersey and Georgia. It has been found that it develops five broods of larvæ each year at Riverton, N. J. Some of the third-brood larvæ, many of the fourth brood, and all of the fifth overwinter in cocoons. Its parasites play a very important part in peach orchards under New Jersey conditions. Two important species have been extensively studied, one a parasite of the egg and the other of the larva. An attractive bait for the moths has been sought. It has been found that fermenting molasses is attractive to these insects and that about 50 per cent of the insects captured were females which had not yet deposited their eggs. Numerous details concerning bait traps are being looked into, such as the type of container and the height of bait from the ground. Cultivation tests were conducted during the spring of 1926 which showed that the overwintering stages in the soil may be destroyed almost completely by two thorough cultivations previous to the issuing of the adults. These cover the insects so deeply in the ground that the moths can not escape. Several

promising insecticides are being tested in the laboratory preliminary to field trials.

Studies on the biology of the oriental peach moth in Georgia have been continued in the laboratory and field and tests have been made of various baits to attract the moths. The prophecy made in my last annual report that the peach moth under Georgia conditions will not be a serious peach pest has been confirmed. The reason is that the latest variety commercially grown matures about midsummer, greatly interfering with the late summer and fall food supply of the larvæ. This is considered very fortunate in view of the fact that the insect during the season of 1925 developed seven generations of larvæ under laboratory conditions in Georgia.

Plum-curculio studies in Georgia have practically been concluded and a comprehensive report on the work has been prepared. The curculio-suppression campaign appears to have been most successful, since not a single complaint of curculio damage to ripe peaches came to the Fort Valley laboratory during 1926. We are now trying to learn the factors involved in arsenical injury to peach foliage and fruit. Tests of other materials for peach spraying have been made, such as the fluosilicates of sodium and calcium, and coated arsenate of lead. Studies have been continued of paradichlorobenzene against the peach borer and a manuscript including the results of five years' work on this

material in Georgia has about been completed. Tests of calcium cyanide as a borer fumigant indicate that the trees are injured by doses large enough to kill the borers.

In cooperation with the Purdue Agricultural Experiment Station, tests conducted during the spring of 1926 at Vincennes, Ind., have shown conclusively that the so-called "cat face" of peaches is caused by two or three species of true bugs, the tarnished plant bug being responsible for the major part. Some of it, however, is caused by two species of *Euschistus*. The types of injury of these insects are well distinguished. Apparently none of them feed to any extent on larger fruit, the injury occurring within a short period after they have fed on the blossoms and small peaches in late spring and early summer. The cleanest orchards are less likely next season to have injured peaches, since late in the season these insects feed largely on weeds. Further tests of paradichlorobenzene have been made on 2-year-old peach trees in late August under extremely high soil temperature and in a very dry soil. Although some small injury resulted, this seemed to have no permanent effect on the trees. It would appear, therefore, that in the Vincennes, Ind., territory the treatment of young peach trees with this chemical in the fall is reasonably safe and less likely to damage the trees than the usual method of worming. On the other hand, the treatment of peach seedling stock in nurseries resulted in serious injury and a number of trees were killed. Observations on the plum curculio in the Vincennes region indicate that the insect may there develop a partial second brood during certain seasons. Wormy peaches at harvest time, however, mostly result from late oviposition of the longest-lived adults of overwintering beetles.

#### GRAPE INSECTS

Work with grape insects at Sandusky, Ohio, in cooperation with the Ohio Agricultural Experiment Station has been continued. The method of applying sprays to vineyards has been further improved, especially the utilization of the "boom" method to meet the various needs of spray applications for the grape-leaf hopper and grape-berry moth. Results from tests of the improved boom in the control of the grape-berry moth compare favorably so far with those obtained by the slow and expensive hand or trailer system of spraying.

There is further evidence that nicotine sulphate in the early spray applications has an effect on the eggs of the grape-leaf hopper. In the Sandusky and Lake Erie Island grape district it has been found that at the time grapes are in condition for spraying for the grape-berry moth, a few days after the grape blossoms have fallen, many nymphs of leaf hoppers have hatched and most of the eggs of the overwintering brood of hoppers have already been deposited in the grape leaves. Nicotine sulphate in grape-berry-moth sprays applied at this time has shown very satisfactory control of the leaf hoppers and is especially valuable in regions where the three-banded grape-leaf hopper predominates.

Studies of the biology of grape-leaf hoppers have been practically completed and include results of several seasons' work. The continued ravages of the rose chafer have necessitated some cooperative work with the State extension service and the State Department of Agriculture of Pennsylvania. Many materials have been tested and a report on the work will soon be prepared. The widespread interest in vineyard dusting, due to demands for methods which require less time than hand spraying, has made it desirable to give special attention to commercial dusting machinery and materials adapted for vineyard use. Although preliminary tests of dust have shown fair control of grape-leaf hoppers under suitable weather conditions, additional work will be necessary before we can judge definitely as to their efficiency in comparison with sprays.

#### CODLING MOTH

During the growing season of 1925 the codling moth was unusually abundant and destructive in many of the principal apple-growing regions. This came about from a variety of causes, especially favorable spring temperatures for oviposition of the moths and warm, droughty conditions during midsummer which favored the development of additional broods. Its damage was especially severe in Kansas and the Ozarks where, in spite of persistent spraying, the quantity of sound fruit at harvest time was greatly reduced.

To meet the situation in Kansas, funds were appropriated by Congress for an investigation of the insect in that State, effective July 1, 1926. In order to cover an entire season, however, arrangements were made to begin investigations, in cooperation with



the Kansas Agricultural College, during the spring with headquarters at Wichita. It is believed that the studies planned and under way will throw much light on the factors involved in the codling-moth problem in that State as well as throughout that general region.

At the Bentonville, Ark., laboratory field experiments in control are being conducted which involve variations in application. This includes the testing of arsenicals applied in various dosages and at various times, and of ovicidal and larvicidal materials. In the spring of 1926, codling-moth studies of questions relating to the quantity of spray residue on fruit at harvest time were undertaken as a major project at the Yakima, Wash., field station. Tests of a large series of baits for moths in the orchard and in packing sheds are also being made. An apple ferment has been found to be the best bait material of those tried, though a ferment of molasses and yeast is also good. Of the various essential oils tested, none show much promise.

At the Sligo, Md., laboratory studies are being made of the feeding habits of the codling-moth larvæ, especially those just hatched, as bearing upon a more effective means of control. The development of insecticides other than the arsenicals is being attempted. At a conference on codling-moth problems in the spring between representatives of the bureau and cooperating entomologists, a thoroughgoing outline of study was prepared which gives special attention to the physiology and behavior of the insect as affording possibilities for more effective control, and by means less objectionable than those now employed.

#### NUT INSECTS

Further progress has been made in the investigation of insects attacking nuts, both in the northern States and in the South. At the French Creek, W. Va., laboratory, studies of the biology of several species of curculios attacking chestnut and hazelnut were practically completed. The hickory twig girdler, a serious pest of pecans in Virginia and North Carolina, as well as several species of *Agilus* beetles, have been studied. A report has been submitted on *Agilus arcuatus* Say, which is seriously injurious to young hickory and other nut-bearing trees.

During the year part of a chestnut orchard located at Bell, Md., was sprayed several times with an arseni-

cal poison in an attempt to check destructive attack by chestnut weevils. Counts of infested nuts of both sprayed and untreated trees showed at the end of the season that the number of larvæ attacking the nuts had been reduced slightly more than 50 per cent by spraying. Infestation, however, was still so extensive that the experiment could not be called a practical success. In view of the fact that species of chestnuts have been found sufficiently resistant to chestnut blight to warrant their planting under certain conditions for nut-bearing purposes, it is felt that further work of this kind should be done.

At the Thomasville, Ga., station work has been confined to a study of the insects injurious to the pecan. In addition to biologic studies of the various species involved, such as the pecan weevil, pecan nut case bearer, pecan shuck worm, and bud moth, attention has been given to control experiments in pecan groves. Various baits likely to attract the moths have been tested. The results thus far have not been very encouraging, but further tests may develop something of value. Additional tests of sprays for the control of the nut case bearer and leaf case bearer are being made. These involve the use of a number of oil emulsions and miscible oils to determine the relative extent to which they will penetrate the winter cases and kill the larvæ. Calcium arsenate, arsenate of lead, and sodium silicofluoride have been applied to trees for the control of the nut case bearer with results not yet checked. Experiments with dusts are also under way, involving various strengths of arsenate of lead and calcium arsenate.

At the Brownwood, Tex., substation for pecan-insect investigations additional biologic data have been accumulated on the various insects injurious to the pecan in that region. In spraying and dusting experiments in the control of the nut case bearer it was found that two applications of arsenate of lead spray, at the rate of 1 pound of the powder to 50 gallons of water to which was added 4 pounds of hydrated lime, soon after the nuts had set, with an interval of about 10 days, and a third application four weeks after the second, gave best results. The damage was reduced from 39 per cent on the untreated plots to 10 per cent on those treated. More than 1 pound of the arsenate of lead to 50 gallons of water gave no additional control. A reduction of over 20 per cent in injury was obtained with three

applications of an arsenical dust composed of 10 per cent arsenate of lead and 90 per cent of hydrated lime. Spraying experiments have been carried out during the dormant season against the so-called obscure scale which is becoming a pecan-insect pest of considerable note. Some degree of control was obtained with various homemade and proprietary oil sprays, but the cooked lubricating-oil emulsions gave best results. Incidentally the Phylloxera was reduced by these sprays.

#### BLUEBERRY MAGGOT

Beginning July 1, 1925, an investigation of the so-called blueberry maggot in Maine was undertaken with headquarters at Harrington. The balance of the summer and fall was largely used in making preliminary surveys, establishing experimental plots, and conducting a general study of the blueberry-maggot situation as existing in Washington County. The blueberry pack in Washington County is said to be valued at more than a million dollars annually, the crop being the most important agricultural product of the county. The blueberry maggot is, when abundant, found in the blueberries after canning, rendering them unsuitable for food. It has been the practice to burn a portion of the acreage every third year and this is generally believed to be destructive to the puparia of the insects in the soil. An investigation shows that this is doubtful, but further experiments will be necessary before positive statements will be warranted. There is, however, apparently an indirect benefit from burning, especially over large areas, through reduction of the food supply of the insects during the following two seasons. The extent of benefit will depend upon the ability of the flies to come in from unburned areas, or the possibility of the puparia carrying over in the soil two years. These points must be studied further. Careful rearing experiments indicate that the adult or fly of the blueberry maggot emerges principally from early July to early August, though this conclusion may be changed by further observations. Experiments are being conducted with calcium arsenate and arsenate of lead dusted over the plants to poison the adults when feeding. This method of maggot control has proved of considerable value in the case of this insect in orchards. Preliminary observations indicate that there was a marked reduction of the

flies on the treated areas as compared with the untreated plots. If it is found that dusting plants with arsenicals during the period of emergence of the flies is a satisfactory remedy, various practical details will require attention, since much of the blueberry barrens are low-yielding lands, paying very small returns. Large-scale growers are already interested in the possibility of applying arsenical dusts by means of airplanes.

#### ORCHARD INSECTICIDES

Further attention has been given to the dipyriddyis and allied compounds as contact insecticides. Some 20 mixtures containing dipyriddyis have been prepared and tested for insecticidal action, one of which has shown considerable toxicity. This is a joint project with the Bureau of Chemistry. Further studies of pyrroles and related compounds have been made and several toxic materials found. Interesting information has been obtained about the relation between chemical structure and toxicity.

The several projects involving oil investigations in cooperation with the Bureau of Chemistry, alluded to in the last report, have been continued and substantial progress made. Two modifications of existing cold-stirred emulsions have been proposed and reported upon. A field method of estimating the percentage of oil in concentrated and spray-strength emulsions has also been published. A study of the size of oil drops in emulsions as related to toxicity to insects has been completed. These studies seem to explain in part why miscible-oil sprays are not so toxic as ordinary soap emulsions when the same oil is used in the two preparations. These and other oil studies in cooperation with the Bureau of Chemistry and various field stations of the Bureau of Entomology are gradually bringing together an increased knowledge of oils and how they may best be used under varying practical conditions.

Further improvement has been made in an insect "olfactometer," and by its use considerable progress has been made in determining the reaction of various species of insects to odors from plant extracts, from plants, and from insects themselves. This field of investigation is promising as pointing out ways for the utilization of materials to attract insects to their destruction, or to repel them from plants. A paper on the senses of the cotton



boll weevil has been prepared. This paper also deals with the general subject of how plants attract insects by smell and it is believed will stimulate further research in this important field.

### PREVENTING SPREAD OF THE JAPANESE BEETLE

This work now forms a distinct section of the bureau in charge of Loren B. Smith. Several phases of investigational work on the Japanese beetle have been brought to a close during the year. New conditions have been brought to light several problems on which it has been necessary to undertake somewhat detailed studies in order to work out the necessary solutions. As a result of the spread during the summer of 1925 it was necessary to increase the quarantined area from 5,122 square miles to 6,047 square miles. This has increased the work of certification of nursery stock and farm products, the movement of which is regulated under State and Federal quarantines. The investigational phases of the work have been broadened and an additional man has been established in India to work on the foreign parasites.

A material known as coated arsenate of lead has been developed which is used as a spray. It consists of arsenate of lead intimately mixed with lead oleate and suspended in water in the form of a paste. The advantage which this material offers over arsenate of lead consists in greater adhesive properties, thereby reducing the number of sprayings which may be necessary to effect the control of the insect. This material is recommended for use on shade trees and ornamental plants. It is unsafe, however, to use it as a general fruit spray since there is danger that too large quantities of arsenic will remain on the fruit at the time of harvest. It is now commercially manufactured and is on the market.

Pyrethrum soap was developed as a contact killer. It has given satisfactory results as a contact spray and, under experimental conditions, kills of 95 to 98 per cent have been made. This material has proved harmless to plants and most varieties can be sprayed several times in close succession without injury to the foliage. The formula for the preparation of the pyrethrum soap has been published, and the soap has been placed on the market by several insecticide companies. The beetles can be at-

tracted in large numbers to a small area with geraniol and then killed with the contact spray.

Under commercial conditions it was found that the alcoholic carbon-disulphide emulsion developed a year ago has certain properties which make it necessary to again improve the formula. This has resulted in the final development of a sodium-oleate carbon-disulphide emulsion, to which is added a small amount of resin. With this improved formula the depth at which a complete kill of the larvæ of the Japanese beetle in the soil can be obtained is increased, and also the danger of injury to the plants is reduced. It is now manufactured and available for general use. The carbon-disulphide emulsion developed at the Japanese beetle laboratory has been adopted in the control of several other insect pests which have hitherto been extremely difficult to suppress. Its use on nursery stock and on lawns and golf courses has been extended and the cost of treatment reduced through improvements in the formula as well as in methods of application.

It appears that arsenate of lead placed in the soil under certain conditions remains effective as a stomach poison for the larvæ of the Japanese beetle for a period of several years. Its effectiveness apparently depends upon the thoroughness with which the arsenate-of-lead powder is mixed with the soil. This has led to the development of a method of treating golf greens that is effective for several years. It was also found that this treatment results in a decrease in the number of weeds and a much purer stand of grass. It is efficacious also against earthworms and other soil-inhabiting insects.

Studies have been continued relative to the development of an arsenical substitute which can be used as a stomach poison for the adult Japanese beetle. In the course of the work the fluorides and silicofluorides of the various metals have been studied. The results of these experiments are not complete, although several hundred materials have been tested. At this stage of the investigational work the silicofluorides of barium and potassium and lead fluoride show promise, and on further investigation may be developed into extremely useful insecticides. In connection with this general study, naphthalene and its derivatives have received some attention as well as many other general chemicals.



Exhaustive studies have been conducted on soap emulsions of aniline, orthotoluidine, xylidine, derrisene, orthocresol, nitrobenzene, and other organic compounds and it has been found that orthotoluidine solutions have given very promising results as contact insecticides.

Extensive studies have been conducted relative to the control of the Japanese beetle under orchard conditions. The question of the protection of apples, peaches, and grapes has received additional attention since it has developed that at the time the Japanese beetle sprays are applied there may be danger, under certain conditions, in applying large quantities of lead arsenate.

Studies have been continued relative to the development of geraniol as an attractive agent for the Japanese beetle and methods have been worked out whereby this material may be used to concentrate the beetles in a relatively small area. It was found that by spraying less than an acre of orchard with geraniol beetles could be drawn in on the leeward side of the orchard for a distance of nearly one-half mile within the first 15 minutes after the spray had been applied. This makes it possible to destroy large numbers of beetles with a relatively small quantity of contact spray. Further work has been done on traps baited with geraniol, and although these will capture large numbers of beetles, it is not felt that a trap has been developed which can be recommended for general use. Increased efforts were made during the summer of 1925 to develop a repellent which could be used on fruit trees without leaving a deposit on the foliage or fruit. It was found that certain odors are distinctly repellent to the beetle, particularly the odor of tar.

General studies of the biology of the Japanese beetle have been continued. During the summer of 1925 large flights of beetles occurred, thousands alighting in Philadelphia on two separate occasions. This flight of dispersion was noticed during the summer of 1923 for the first time and lasted a relatively short time. The flight during the past season, however, was much more extensive, and the beetles occurred in the cities of Camden and Philadelphia in greater numbers than at any previous time. Observations indicate that they had flown a distance of several miles. These periodical flights are extremely serious from the standpoint of the

operation of the quarantine, since while they are in progress almost any public carrier or vehicle is likely to become infested.

Continued progress has been made in the liberation and rearing of several species of parasites. The tachinid fly *Centeter cinerea* Aldrich, introduced from Japan and found to be established in this country last year, survived the winter of 1925-26 in a satisfactory manner. Large shipments of the dextiid fly *Prosenia siberita* Fab. were received from Japan and successfully reared and liberated. It has been found possible to collect and ship adult *Tiphia* from China and Japan to Riverton, N. J., with relatively small mortality. As a result the method of handling the various species of solitary wasps has been changed and large shipments of the adults have been made. With this method of shipment much larger series have been liberated than were heretofore possible. Shipments of *Dexia ventralis* Aldrich were received in the spring of 1926, and it is anticipated that this valuable parasite can be successfully established.

The Bureau of Entomology has co-operated with the States of New Jersey, Pennsylvania, and Delaware, and with the Federal Horticultural Board in the enforcement of quarantines to prevent the spread of the Japanese beetle. These have been enforced to the fullest possible extent with the funds available. A revision of the quarantine, effective March 21, 1925, included an area of 5,122 square miles. A further increase in the quarantined area was made effective December 23, 1925. The area now under quarantine contains a population of more than three million people. During the summer of 1925 the inspection included sweet corn, peas and beans in the pod, vegetables with tops, hay, straw, and forage crops moving from the Philadelphia, Camden, Wilmington, and Trenton markets as well as direct from the farms. The inspection also included nursery, ornamental, and greenhouse products, sand, soil, earth, peat, compost, and manure. The inspection of farm products was operated during the period June 15 to October 15, whereas the inspection and regulation of the movement of nursery stock and nursery products was effective throughout the year.

As a result of the scouting operations in 1924, three beetles were found at Milton, Pa., at a distance of about 100 miles from the quarantined area. During the summer of 1925 an ex-

termination campaign was successfully conducted at this point.

In New Jersey 902,340 packages of farm products were certified for shipment to points outside the area between June 15 and October 15; 106,832 beetles were removed by inspectors from sweet corn, consigned largely to New York City; 7,223 beetles were removed from beans, and 61 beetles removed from miscellaneous produce. On the highways in New Jersey 11,264 trucks of produce were examined at the boundaries of the quarantined area to assure that the produce had been properly certified before leaving the quarantined zone. Two hundred and four vehicles stopped by road inspectors were found to be without the proper certificate. Eighteen wilful violators were prosecuted under laws of the State of New Jersey; 2 individuals were fined \$100 each; 5 were fined \$50 each, and 11 were found guilty and held under parole of the inspectors and assessed the costs of the court. A total of 17,503 carloads and 431 boatloads of sand or soil were certified and in many cases treated before certification for shipment out of the regulated area in New Jersey. These shipments were consigned to 35 States in addition to Canada, France, and Porto Rico. Six hundred and thirteen cars of hay or straw were shipped from the Hightstown area of New Jersey under certification to 12 States during the summer of 1925. Shipments of 24,235 bales of sphagnum moss were made under certification from New Jersey to 20 States. During the year January 1 to December 31, 1925, there were shipped from the Japanese beetle area under certification 13,404,396 nursery plants. These were consigned to every State in the Union and Province in Canada, and 13,888 to foreign countries.

The inspection and certification of farm produce in Pennsylvania relate particularly to the markets and commission houses in Philadelphia, since very little grown on farms outside of the city is shipped to points beyond the quarantined area. In all, 25,190 certificates were issued in Pennsylvania for the transportation of farm products to points outside the quarantined area, 95,842 for nursery stock, and 8,819 for carloads of sand. Efforts toward the enforcement of the quarantine were centered on the commercial carriers of produce, who transported large quantities from the markets. Unless there was visible evidence of violation private or touring

traffic was not interfered with on the roads. Through cooperation with the Pennsylvania State police a detail of the State constabulary was assigned to the Japanese-beetle project during the summer and greatly assisted in enforcement. Fifteen prosecutions were made against wilful violators of the quarantine provisions. Prosecutions were made under Pennsylvania State law, and in every case convictions were obtained and fines of \$5 to \$100 were obtained. In Pennsylvania a very large quantity of nursery stock was treated with carbon-disulphide emulsion that it might be shipped under certification. In the autumn of 1925, 10,421 treatments were made in 11 large nurseries. In the spring of 1926, 29,804 treatments were made; of these, 1,710 plants were rejected and not certified for various reasons. In Pennsylvania during the year 1,665,761 nursery plants were inspected and certified for shipment out of the area.

The quarantine work in the State of Delaware consisted largely in the inspection and certification of farm products; very little nursery stock is grown in the area now under quarantine in that State. Thirty-one carloads of sand were shipped out of the quarantined area under certification during the year. The State Department of Agriculture adopted a quarantine measure requiring inspection of all peaches consigned to points outside the regulated area. In all, 5,163 baskets and crates of peaches were inspected and 14 beetles were found. This State also maintains an inspection of empty baskets returned from Philadelphia to points beyond the quarantine line in Delaware. During the season 30,728 baskets were inspected. In all 86,047 packages of farm produce were inspected and certified for shipment to points outside the quarantined area in Delaware.

The system of quarantine operations has not been materially changed during the fiscal year. Inspectors are placed on all important roads leading out of the area for 24 hours a day and the road-inspection force is supplemented by State police wherever possible. It is the duty of the road inspectors to check up on vehicles hauling contraband articles out of the area. On all roads at the periphery of the area are placed large, conspicuous signs, stating the principal facts concerning the quarantine and the products under quarantine, for the information of the traveling public. Within the quarantined area temporary offices are maintained, where inspectors are stationed



and are available to the growers or shippers of produce on call to make the necessary inspections and certifications. Corps of inspectors are also maintained in the larger nurseries during the shipping season. In the enforcement of the nursery quarantine, where it is necessary to treat chemically the soil about the roots, a separate division of the quarantine organization is maintained, which performs the necessary treatments of all soil designed to be shipped out of the quarantined area. Scouting is systematically conducted by corps of men outside the known infested area in order to determine the annual spread of the insect. It has thus been possible to maintain an effective organization, both from the standpoint of the shipper and from that of enforcement of the stringent regulations.

#### **WORK ON THE GIPSY MOTH AND THE BROWN-TAIL MOTH**

This work has continued under the direction of A. F. Burgess. There has been close cooperation with all of the infested States with encouraging results.

#### **FIELD WORK IN THE BARRIER ZONE**

At the close of the last fiscal year an inspection of all the towns in the barrier zone in western New England and eastern New York was made and several small colonies found in towns that had not been scouted previously.

A group of towns directly west of the zone area in the Adirondack Mountain region, a number of towns in the Mohawk Valley and in the Catskill region, Westchester County, N. Y., and that portion of Connecticut between the zone and the New York State line were inspected.

It was arranged that the conservation commission of the State of New York should handle the barrier-zone work in that State south of Washington County and scout-selected areas in the Mohawk Valley, the Catskill region, and Westchester County, and do the necessary work on Long Island. The bureau handled New York State north of Washington County together with the zone area in Vermont, Massachusetts, and Connecticut, as well as the extreme western section of Connecticut.

This program was completed excepting part of the Mohawk and Catskill areas. These areas will be scouted during the next fiscal year. The necessity for this work was empha-

sized by the finding of a well-established colony in Greenwich, Conn., near the New York State line. A small infestation was found in the town of Kingston, N. Y., by the State force. It is thought that these infestations have been exterminated.

Less infestation has been found in the barrier zone than during the previous fiscal year, the insect has been exterminated in some of the colonies, and the quarantine was lifted from this region at the end of the fiscal year. This includes 71 towns in Vermont, 33 in Massachusetts, and 5 in Connecticut. Early in the year the towns of Cheshire and Wallingford, Conn., which adjoin the zone to the eastward, were thoroughly scouted and the quarantine lifted. These towns have been added to the barrier-zone area and with the other zone towns therein will be subject to periodical inspection and patrol.

The plan of work for the next year provides for a thorough inspection of a considerable number of towns within the western limits of the barrier zone, and if no infestation is discovered work in them can be discontinued for several years, after which a final inspection should be made before they are eliminated from the zone. Preliminary work is also planned in some of the towns adjoining the zone to the eastward. This should result in additional protection to the zone and pave the way for a gradual reduction of the infested area in New England.

The gipsy-moth colony found at Henrysburg, Quebec, by the entomologists of the Dominion of Canada in 1924 was thoroughly treated in 1925 and the infestation greatly reduced. Extirpation should be reached this year.

The gipsy-moth colonies on Long Island have been carefully treated by the New York Conservation Commission and should be cleaned up by the end of another year.

#### **FIELD WORK IN NEW JERSEY**

A strip of towns averaging about 10 miles wide just outside the infested area was inspected in New Jersey. One infestation was found in Elizabeth, and it has been exterminated. Another strip just within this border has been very carefully scouted during the present fiscal year. Two infestations were found, one in Readington and the other in Warren Township. They have been carefully treated and the areas and their surroundings thoroughly sprayed, fish oil



being added as a binder to the arsenical. The central part of the infested region has also been given attention and much spray has been applied, especially on the wooded ridges north of Somerville and Bound Brook.

Light sprayer trucks built last year were operated very successfully this year under varying conditions and demonstrated their usefulness when pressures not exceeding 400 pounds were needed. In order to obviate the delays and loss of time occasioned by the necessity of hauling water in cases where a truck can not be set at the water supply, several small portable triplex pumps driven by a small gasoline engine were obtained. They were mounted on skids and could be easily set up at the water supply. These pumps were used for filling the tanks on the sprayers. They can fill a 400-gallon tank in about 15 minutes by pumping through a 2,000-foot hose line if the water does not have to be forced up too great an elevation. Much time was saved and a greater volume of spraying was made possible by using these pumps.

#### QUARANTINE AND INSPECTION

During the year there has been an increase in the number of certificates and permits issued, the total being 147,694 as against 121,410 for the previous year. The number of egg clusters of the gipsy moth found on shipments was more than 50 per cent less than the year before. Thorough inspection and treatment were enforced before shipments were allowed to move.

Heavy shipments of Christmas trees and greens were forwarded late in the fall and most of the scouting force in New England had to be detailed to that work. Each tree was examined individually and over 100 inspectors were used. The total shipments aggregated 1,033 car lots, 1,018 small lots, and 169 auto-truck shipments. This was about 12 per cent more than the shipments of the previous year. They were consigned to 33 States and the District of Columbia.

#### FIELD AND LABORATORY RESEARCH

The European work was rearranged during the winter and provision was made to place two experts in eastern European countries to study gipsy-moth conditions and investigate the biology of some of the parasites of the gipsy moth about which essential information is lacking. Another ex-

pert made a survey of gipsy-moth conditions in Spain, Portugal, and northern Africa and then proceeded to Hungary, Poland, and Czechoslovakia, where intensive collecting was done to procure parasites for shipment to the Melrose Highlands laboratory. Over 125,000 specimens, most of them in the form of tachinid puparia, were received in 1926.

Methods of packing and shipping have been improved so that the mortality has been greatly reduced as compared with previous years.

Some heavy gipsy-moth infestations accompanied with severe defoliation have been found in these countries, particularly in Hungary, and the data collected are likely to have an important bearing on what may be expected in the United States in the control of the gipsy moth by certain imported parasites.

Colonization of parasites from the Melrose Highlands laboratory has been continued. Over 3,500,000 specimens of all species have been liberated. Most of these were placed in sparsely infested areas in the New England States, a few were sent to New Jersey, and some of the species recently imported were colonized in the badly infested territory on Cape Cod, Mass. Several shipments of *Schedius kuvanae* How., one of the imported egg parasites of the gipsy moth, were sent to Spain and northern Africa to assist in abating the gipsy-moth menace in those countries. The aggregate parasitism in the United States by all species has ranged slightly higher than last year when parasitism reached the lowest level recorded for a series of years.

Field-spraying experiments were conducted in the town of Sandwich, Mass., to test the effect of treatment with arsenate of lead when used at various quantities per acre, with and without fish oil as an adhesive. These tests were checked by the use of small field plots. Most of the trees in the plots were protected from defoliation, whereas contiguous woodland covering hundreds of acres was completely defoliated.

A series of experiments were also conducted in Sandwich, Barnstable, and Falmouth, Mass., to test the utility of an airplane for dusting woodland. Several plots averaging about 25 acres in area were selected in the midst of heavily infested woodland. Such factors as high wind velocity, heavy fog, and other atmospheric conditions greatly retarded the progress of the work. The results were more

satisfactory than any that have been attempted heretofore by this division and a mass of valuable data has been obtained bearing on this method of applying insecticides, although we have not yet formed a final judgment as to the practicability of the method.

### PRESENT CONDITIONS

The brown-tail moth is somewhat more abundant than last year, particularly in southwestern Maine and southeastern New Hampshire. Parasitism averages slightly less.

A hurried survey of the area infested with the gipsy moth indicates that there has been a marked increase in abundance throughout the eastern part of the territory. Defoliation has been noticeable and more or less continuous in eastern Massachusetts both north and south of Boston. Most of the trees in this territory except on Cape Cod showed little trace of defoliation last year. A number of isolated areas, some large and others small, have been reported in widely scattered places, viz., Thompson, Conn.; Deerfield, Mass.; Springfield, Vt.; and Concord, N. H.

The conditions on Cape Cod are far more serious than last year. Large areas of woodland were defoliated before the caterpillars became half grown. Frequently the tender bark of the twigs was eaten and millions of the hungry caterpillars perished from starvation. This condition prevailed over thousands of acres of woodland extending in many localities as far as the eye could reach. The best estimate that is available at present indicates that 47,000 acres were completely defoliated and 11,000 acres partially defoliated on Cape Cod this year.

Present conditions indicate that there will be heavy defoliation in the eastern part of the infested area next summer. Should the insect increase as rapidly in the next few years west of the Connecticut River, the difficulty of keeping the barrier zone free from infestation will be greatly increased.

### CEREAL AND FORAGE INSECT INVESTIGATIONS

W. H. Larrimer has been in charge of the work of this section of the bureau.

#### EUROPEAN CORN BORER

The situation as regards the European corn borer has not changed very importantly since my last report. The

advance of the insect toward the Corn Belt on the extreme western border of the infested area was comparatively slight during the year except in the "thumb" section of Michigan. Here the area more than doubled in extent, probably by flight of the moths from the near-by intense infestation in Ontario, Canada. In western New York and Pennsylvania, however, there occurred a very great increase in area of infestation, the eastern border of which reached well into the "finger-lake" region of New York and as far east as Tioga and Lycoming Counties in Pennsylvania.

Serious injury did not occur to the American crop during the year, but on the Canadian side of Lake Erie immediately opposite Detroit and Toledo an area of at least 400 square miles of excellent cornland suffered a complete loss. This occurrence naturally aroused intense alarm on the part of American growers and agricultural officials.

In the fall of 1925 a general conference of American and Canadian agricultural officials, experiment-station directors, agronomists, and entomologists was held at Windsor, Ontario, to discuss the problem of corn-borer control from an international standpoint. This discussion resulted in a crystallization of opinion as to the necessity for strenuous and immediate action. The conference appointed a committee consisting of influential agriculturists and experiment-station directors of important corn States to act in a general advisory capacity and to urge concerted action by every means possible.

The work of introducing the natural parasitic enemies of the corn borer from Europe has proceeded most satisfactorily. In addition to the parasites formerly reported as established, three additional species, making five in all, may now be considered as having become established. Several new and promising parasites have been discovered by the bureau's investigators in Italy and France.

The States of Michigan, Ohio, and Pennsylvania have promulgated compulsory clean-up regulations and favorable results are becoming apparent.

Among the most important and promising recent results of the bureau's co-operative investigations has been the development of agricultural machinery to meet, in an economical manner, the needs of the corn-borer clean-up requirements. It has been amply demonstrated, both in Europe and in this country, that the control of this pest depends largely, if not principally,



upon the manner of disposal of the cornstalks and cobs. To combat the insect in its winter quarters it is necessary to destroy or ensile the entire stalk of the plant. It has been the aim of those engaged in the investigation of machinery for this purpose to originate a device which will cut the corn at the ground line and which can be attached at reasonable cost to the existing corn-harvesting machinery. This end has now been achieved largely through the efforts of L. H. Worthley, in charge of the bureau's control work, with the active and whole-hearted cooperation of the department of agricultural engineering of the Ohio State University. The large-scale manufacturers of farm machinery have adopted the device and are placing it on the market for use this year. In addition there has been brought to a high state of development machinery which it is believed will successfully pick and husk the corn and shred the residue for silage or to be returned immediately to the soil, at little if any increase in present harvesting costs. The cooperation accorded not only by the States directly involved but by individual officials of the Corn Belt States has been satisfactory and important. On the whole it is felt that a distinct advance has been made on this problem during the year.

#### ALFALFA WEEVIL

The principal events with regard to the alfalfa weevil have been the extension of the weevil territory into eastern Wyoming; the scouting of the weevil territory in southern Utah, southern California, northeastern Oregon, southeastern Washington, southern Montana, and eastern Nevada; a severe attack of the weevil in western Nevada and northern Utah; a suspended attack in western Idaho; some encouraging dusting experiments with land machines in Nevada and with airplanes in Utah; tentative studies of temperature control of the insect; the continued introduction and study of European parasites of the weevil; and the preparation of a Farmers' Bulletin and a motion-picture film describing the life-history stages and control of this insect.

The extension of the weevil territory to eastern Wyoming marks the entrance of the alfalfa weevil into the Mississippi Valley and also into a climate decidedly different from that in which it has heretofore been studied, the principal differences be-

ing the coolness of the winters and the concentration of rainfall during the spring and summer months instead of in the fall and winter, as in the regions west of the Rocky Mountains. The territory where the weevil occurs in eastern Wyoming is practically continuous with the alfalfa-growing areas in Nebraska and Kansas.

Our knowledge of the geographical distribution of the alfalfa weevil has been brought nearly up to date. The territory has been outlined in southern Utah, southern California, eastern Oregon, southeastern Washington, southern Montana, and eastern Nevada, and the work is at present being continued in western Idaho, northern California, and central Colorado. No important extensions of the weevil territory have been found since July, 1925, but there has been a slight general advance all around the border.

The most serious attack of the alfalfa weevil since 1921 has occurred in western Nevada and northern Utah. In both localities the damage has been general, very few fields escaping serious damage to the first crop, although the weather was generally favorable for early cutting. A similar outbreak began in western Idaho, but ended prematurely. An outbreak which was anticipated in central Utah, because of the extremely warm spring, did not develop.

The suspended and incomplete attacks of the pest in Idaho and central Utah are perhaps the most important events of this whole year, as they throw light upon the control of the weevil by climatic influences. The interruption of the attack in Idaho is closely correlated with a cold, wet week which occurred at the height of this oviposition period (for that locality) but too early to have a similar effect in Nevada and Utah. The absence of damage in central Utah seems to be due to the very early maturity of the crop itself, but as we had no observer stationed there our facts are too meager to justify a theory.

Parasite studies have been divided between a survey of parasite abundance in the regions surrounding Salt Lake City and Heber, Utah, and the rearing and liberation of parasites collected by the corn-borer laboratory in Europe. Dissection of larvæ from alfalfa fields during the latter half of 1925 and early 1926 shows relatively few parasitized by *Bathyplectes curculionis* Thoms. in the Salt Lake Valley, increasing in certain instances in 1926, and large numbers parasitized



at Heber. Mymarids, as yet undetermined, have been reared from eggs collected in the fields at Salt Lake City, and the same or a related species from eggs of the clover leaf weevil. Cocoons of *Microbracon tenuiceps* Mues., parasitic upon larvæ of the lesser clover leaf weevil, have been reared artificially upon alfalfa weevil larvæ.

A motion-picture film has been prepared for the use of the extension service, largely on the initiative of the director of extension of the University of Nevada. Pictures of weevil work, of life history, and of control and quarantine measures, made in the field, were rounded out by animated cartoons made by the motion picture laboratory, and are in use. Additional pictures of adults and larvæ and of airplane dusting have just been completed and are to be included in the film.

#### HESSIAN FLY

The Hessian-fly investigations have been continued along the lines as previously reported. Infestation data, recorded and interpreted with respect to the time of sowing and climatic conditions, have been obtained for the year from all the principal wheat-growing areas. Biological and ecological studies have progressed well. In general, no widespread serious damage has occurred to wheat because of this pest during the year. This is primarily because of a combination of unfavorable weather conditions and the general observance of control measures. The situation in Kansas continues to be a source of considerable anxiety.

#### CEREAL AND FORAGE INSECTS IN GENERAL

Under the cereal-insect group continuation studies have progressed on such major pests as the jointworms, chinch bug, white grubs, wireworms, the sorghum midge, cutworms, webworms, billbugs, the corn ear worm, and the green bug. Several of these insects were also studied as to their damage to forage crops, and in addition special studies were continued on the alfalfa seed chalcis, grasshoppers, army worms, and lesser clover leaf weevil and other clover weevils. Several technical papers and Farmers' Bulletins dealing with the various phases of the life habits and control of these species have been published and several more are in manuscript for publication.

#### SOUTHWESTERN CORN BORER

This pest continues to hold potential importance and the situation regarding damage by it in New Mexico, eastern Arizona, and western Texas has not changed materially during the year. No funds have been made available to finance a real study of this pest. Such observations as have been possible by workers on other problems confirm our former opinions to the effect that a thoroughgoing investigation should be started just as soon as possible.

#### SUGAR-CANE AND RICE INSECTS

During the fiscal year a study of the control of the sugar-cane mealybug at Cairo, Ga., was completed.

Careful status studies were made of the sugar-cane moth borer in Louisiana, and in cooperation with the Bureau of Agricultural Economics it was estimated that it caused in 1925 a loss of 30 per cent of a full crop. This is the greatest loss from the moth borer since 1916. The publication annually of a cooperative estimate of damage has served to focus attention on the work of this insect as never before.

The tachinid parasite introduced from Cuba several years ago was found to be still present in Louisiana, though in such small numbers as to have no effect on the control of the moth borer. At the request of the Bureau of Plant Industry, and with the cooperation of the Tropical Plant Research Foundation, the same parasite was sent from Cuba and liberated at a field station of the Bureau of Plant Industry in Florida.

Calcium cyanide was tried as a fumigant for seed cane, but without success. It was hoped that hibernating larvæ of the moth borer in the stalks could be killed.

Preliminary experiments in applying dusts to sugar cane with the object of poisoning the moth borer were conducted.

Sodium fluosilicate was found to be very effective against the striped blister beetle when dusted on soy beans. Soy beans were recommended as a rotation crop on rice plantations, but the blister beetle was such a serious pest that this recommendation was not adopted. The discovery of the use of sodium fluosilicate as a control measure is bringing about a general planting of soy beans, which will be of great benefit to the Louisiana rice planters. Two manuscripts

were written on this work. The life history of the striped blister beetle is being carefully studied.

By a number of large-scale tests the exact damage to rice from the rice water weevil is being worked out. Information is being accumulated on the various rice insects, and a comprehensive manuscript is in preparation.

### STORED - PRODUCT INSECT INVESTIGATIONS

E. A. Back has continued in charge of this section of the work of the bureau.

#### BEAN WEEVILS

The investigation of weevils attacking beans and cowpeas has been continued along the same lines as last year. The results of the practical field control obtained this year have formed an excellent sequel to the field work on bean plantations of last year. The data have so impressed the California State Department of Agriculture and the industrial bean growers in California that heartiest cooperation has been established. The collection for examination at time of harvest of samples of beans from various plantations has made it possible for the bureau officials to predict conditions on various plantations with certainty.

#### GRAIN INSECTS

During the year many new scientific data have been published in bulletin form as a result of the work of the bureau on the biology of grain pests. Other publications are under way. The work in Georgia on the rice or black weevil has continued along the same general lines. These studies strengthen still more the idea that the rice weevil can best be controlled by intelligent control in storage by fumigation. On isolated farms where no control has been instituted for several years field infestations at time of harvest in certain instances ran as high as 98 per cent of all ears of corn. In other fields well isolated by woodland, or near farm buildings in which the stored corn was intelligently fumigated, field infestations were less than 1 per cent of the total ears.

#### GRAIN FUMIGANTS

Cooperative work with the Bureau of Chemistry has been continued with the object of finding a safe, cheap fumigant that will be as effective as carbon disulphide for the treatment

of infested grain. Many new compounds have been tested and several of the more promising have been selected for large-scale tests.

#### ANGOUMOIS GRAIN MOTH

Our work has thrown much light upon the biology of this great pest. Of special importance to the farmer has been the information obtained as to the stage of growth of the wheat plant when infestation may occur, the importance of control in storage to prevent field infestation, and the premium placed on intelligent control.

#### DRIED-FRUIT INSECTS

The support given last year to the bureau's investigations of insects destroying dried fruits and vegetables, by the California Dried Fruit Association, has been continued this year. A thousand-dollar donation by the association has made it possible to give more attention to the work. Aside from the studies of the biology of the insects involved, large-scale practical experiments have been under way to determine the value of metal barriers and oiling of the processed fruit, particularly raisins, in preventing infestation. This work is nearly completed. Other fruits, such as peaches and prunes, will soon receive attention.

#### MOTH-PROOFING SOLUTIONS

Although the results so far are not such as to indicate that complete and permanent immunity against fabric pests can be obtained by the use of moth-proofing solutions, certain solutions have been proven of decided protective value. Whether brushes and furs can be satisfactorily treated is yet to be determined. The value of epsom salts alone as a moth-proofing agent appears to have been disproved by the work of the year.

#### FURNITURE PESTS

The continued vogue for overstuffed furniture has greatly increased the demands upon the bureau for information regarding furniture pests, and these insects have been studied during the year. Two short articles have been published and a well illustrated bulletin is in preparation. This work has received the cooperation of the American Furniture Warehousemen's Association and of the National Association of Upholstered Furniture Manufacturers.

## TROPICAL AND SUBTROPICAL FRUIT INSECT INVESTIGATIONS

A. C. Baker is now in charge of this work.

### FRUIT FLIES IN HAWAII

Investigations of fruit flies in Hawaii, including inspection and certification work in cooperation with the Federal Horticultural Board, have been continued. The total of 289,796 packages inspected during the year is an increase of 25,733 over 1925 and 52,141 over 1924. Baggage inspection also increased by 275 trunks over 1925.

Studies on the susceptibility of cooking bananas proved them possible carriers of the fruit fly and as a result no modification of the quarantine was recommended to the board. An investigation of the susceptibility of onions was made at the request of the board and this indicated that the onion is highly resistant to infestation by the fly. Avocado studies have been continued but sufficient data are not available to permit recommendation in regard to the quarantine regulations touching Guatemala varieties. Two successful shipments of 2,202 fruit-fly puparia parasitized by *Opinus humilis* Silv. were made to the department of agriculture, Paget, East Burma, and an unsuccessful attempt was made to ship 1,294 puparia in cold storage to Palestine.

### FRUIT FLIES IN THE CANAL ZONE

Studies on tropical-fruit insects have been continued in the Canal Zone and special attention given to investigations of fruit flies. Ant control with calcium-cyanide dust has been further studied, and as a result the Republic of Panama has adopted this fumigant and started an intensive campaign. Tests of various wood treatments against termites are being continued in cooperation with the division of forest insect investigations, and a test building is now being erected in Barro Colorado Island. Time has been given to the rubber, abaca, and chaulmoogra introductions.

### CITRUS THRIPS

The infestation of the citrus thrips has been more pronounced this year than any season since 1922, and efforts toward a satisfactory control have been continued, 66 acres being now under treatment. The biological work on the thrips has been practically completed.

## FLORIDA CITRUS INSECTS

The work in Florida during the year has been largely confined to a study of the citrus aphid and a study of oil sprays. The aphid work has consisted of control experiments and a study of the factors giving rise to the recent epidemic. The conditions are now fairly well charted and it is expected that sufficient information will be available to permit prediction in future cases. The influence of climatic factors on the rise and fall of the aphid populations and their counter populations of predatory enemies, parasites, disease organisms, etc., has been studied in detail under natural conditions by quantitative methods. Many interesting successions have been discovered which support predictions made on theoretical grounds. Since an accurate knowledge of the influence of climatic factors on the various biological agencies involved in an epidemic is essential for prediction, we have carried the leads from natural conditions into the laboratory. We have therefore equipped the laboratory with an outfit in which temperature, humidity, light, and air movement can be controlled.

The work on oil sprays has included experiments with oils, oil emulsions, and emulsifiers. This has touched on the so-called quick-separating emulsion as compared with good soap emulsions, the effect of oil sprays on the size and maturity of the fruit, the relation of temperature and mechanical agitation to the size of the globules, and the preservation of emulsions with emulsifiers or stabilizers.

### GREENHOUSE INSECTS

Owing to the increasing importance of the bulb industry, particularly since the placing of the quarantine on narcissus bulbs, we have been forced to curtail some of the greenhouse work to give attention to bulb pests. A survey of the Pacific coast bulb fields was made during June and July, 1925, a full report of which was given at the bulb conference last November. The narcissus fly was found to be a primary pest in some of the west-coast plantings. An examination of recent commercial plantings on the east coast during April, 1926, indicated that flies had not yet gained a foothold, excepting in some of the Virginia plantings.

Biological experiments and certain control experiments on bulb flies have



been conducted in Washington. A series of tests with carbon disulphide at normal atmospheric pressures showed that the time factor necessary for sufficient vaporization resulted in severely injured bulbs.

Fumigation under vacuum has been tried in a preliminary way with various dosages and exposures. Flies and mites were controlled, but the treatments resulted in injury to the bulbs.

The work in California has included biological studies of bulb pests and studies on hot-water treatment. The tests made have substantiated the statement that immersion at 110° F. for three hours is fatal to the flies and mite.

Experiments in fumigation with hydrocyanic acid gas, in cooperation with the Bureau of Chemistry, have been conducted in Washington. The primary object here has been the correlation of the resultant mortalities of certain greenhouse insects with the comparative rates of evolution of gas generated from equivalent quantities of cyanogen, whether calcium cyanide, sodium cyanide, or liquid hydrocyanic acid is used as the source. Observations on the possible variation in diffusion or stratification of the gases at various elevations are being made and the influence of temperature and humidity considered.

#### CAMPHOR SCALE

Work has been continued with the camphor scale and other scales. During the latter part of the year time has been given to bringing together in the raw form all the data gathered since the inception of the work. A careful analysis of these is now being made, with a view toward determining the conclusions possible and the future needs of the problem.

#### TRUCK-CROP INSECT INVESTIGATIONS

Work on the project of vegetable and truck-crop insects has been continued under the direction of J. E. Graf.

#### SWEET-POTATO WEEVIL

Additional progress has been made on the eradication of the sweet-potato weevil in the States of Alabama and Mississippi and in two of the three eradication projects in Florida. In Mississippi there was a division of the work, the State plant board taking over the eradication campaign in the counties of Harrison and Jackson and the bureau limiting its activities to

Pearl River and Hancock Counties. Clean-culture methods were conducted by inspectors and agents and clean planting stock furnished to the farmers of all properties known or believed to be infested. At the close of the year 10 properties were known to be infested in Pearl River County, 9 of these being new infestations and 1 a hold-over. In Hancock County 21 properties were known to be infested at the close of the year, 9 of these being new infestations.

In Alabama the work followed closely the methods used in Mississippi, except that clean planting stock was not supplied to the growers. In Baldwin County the considerable increase in the number of infestations was traced to a new infestation center in which many of the wild host plants were infested. Additional assistance was furnished by the State of Alabama and Baldwin County, and as no potatoes were grown on the infested properties it is now believed that the situation is well in hand.

In the Baker-Charlton eradication project in Florida every farm was inspected twice and some of the more suspicious properties several times. All of the stored potatoes in the previously infested area were examined and no weevils were found. This was most encouraging, since the Baker-Charlton area was the first eradication zone to be set aside by the Bureau of Entomology. In the Lilly eradication project in southern Florida inspections during the fall of 1925 and spring of 1926 showed all farms to be apparently free of the weevil. This project, although small, is of great importance since sweet-potato culture in the southern part of the State is on a different plan, most of the young plants for the fields coming from "stand-over" plant beds in which the infestation is carried readily from year to year. The Seffner eradication project in the vicinity of Tampa has not given good eradication results, most of the farms again showing infestation by the weevil during the present year, though in smaller numbers.

#### MEXICAN BEAN BEETLE

The Mexican bean beetle continued its spread in the East, invading many new counties in Tennessee, Kentucky, and Indiana along the western edge of the infested area, and in Pennsylvania, West Virginia, Virginia, and North Carolina along the eastern edge. Beans suffered severe injury in the more hilly sections of Tennessee,

Kentucky, West Virginia, Virginia, and Ohio.

Tests with new insecticides including a large series of fluorine compounds were made during the year. Of the compounds tested, sodium fluoride, barium fluoride, sodium silicofluoride, and barium silicofluoride were the most toxic. Tests with sodium silicofluoride indicate that this is a very promising insecticide for the bean beetle.

Studies in New Mexico showed that the successful hibernation of the bean beetle is confined to the yellow-pine (*Pinus ponderosa*) region where oak trees are associated. During the last two seasons in the area above this region, 15,500 beetles perished in hibernation without a single case of survival. Below this region in the pinyon belt, only 30 beetles emerged from a cage containing 2,500 insects. In the short-grass region of the Estancia Valley only 4 beetles survived out of 10,487 used in the hibernation studies. Tests conducted with marked beetles furnished additional evidence that the insect follows prevailing winds and flies either up or down canyons, which are the principal migration paths.

#### PEA APHID

By trapping migrating pea aphids on sticky screens it has been found that in Wisconsin there is usually a heavy migration of the insect about July 10, and that this migration complicates control methods, for it comes at a time when most of the pea vines are in pod. Owing to the unusual climatic conditions the pea vines made a heavy growth, and as the infestation appeared relatively late it was necessary to sweep the fields at the time the vines were in pod and unusually large. Considerable damage was done to the vigorous vines by the machine. In most cases the size of the yield from fields swept with the aphidozer was less than that of untreated plots, but in every case the peas from the swept areas were of higher grade. In several instances this difference in grade resulted in a higher return per acre from swept plots than from adjacent unswept plots, despite the fact that the total yield in unswept plots was higher.

In California tests of nicotine dust for the control of the pea aphid were continued. Homemade dusts prepared with a self-mixing duster were used, and in one field of market peas three applications of nicotine dust were

made at a cost of \$56.80 per acre, which successfully controlled the pea aphid, and resulted in a net profit of \$80 per acre over untreated fields. A reduction in the number of applications did not give such good control of the insect, but in one field a single application costing \$14.65 per acre resulted in a net profit of \$17.12 per acre over undusted fields.

#### TWELVE-SPOTTED CUCUMBER BEETLE

It was found that the situations selected for oviposition by the twelve-spotted cucumber beetle are influenced by the quantity of moisture in the soil and its physical condition, a soil with cultivated or roughened surface being preferred if sufficient moisture is present.

#### POTATO AND TOMATO INSECTS

##### SEED-CORN MAGGOT

Field and laboratory studies have been conducted on the influence of weather conditions and other factors responsible for infestation by the seed-corn maggot. It has been found that the eggs of the adult fly are not normally deposited on freshly cut pieces of seed potato, even though these are left exposed in the field for several hours. The young maggots do not feed on healthy pieces of potato seed, but if decay is present the maggots enter these spots and develop without difficulty. It appears from the work to date that the maggot attack normally follows seed-potato injury or decay. It has been found that planting methods which tend to preserve the seed and prevent rotting or burning throughout the germination period will lessen injury by this insect.

##### TURNIP OR AUSTRALIAN TOMATO WEEVIL

Work was continued on the turnip or Australian tomato weevil at the laboratory in southern Mississippi. This insect has continued to spread, and is now found in 24 counties in southern Mississippi, 8 parishes in Louisiana, 7 counties in Alabama, and 2 counties in Florida. It has recently been found in the vicinity of Santa Cruz, Calif., attacking carrots. It shows very little activity during mid-summer, and apparently the principal spread takes place in the fall, winter, and early spring. Tests with various arsenicals in both the spray and dust forms have given good control.



## TOMATO FRUIT WORMS

It was found in Louisiana that practically all of the eggs of the tomato fruit worm were found on the terminal growths, the taller plants apparently being preferred for oviposition. If this is a normal habit of the insect, it will aid in disclosing serious infestations in sufficient time to permit the application of remedies. In North Carolina good control of the tomato fruit worm was obtained by the use of the mole-cricket bait, modified by the addition of a small quantity of molasses. This bait was scattered over the plant, and as the worms migrated from fruit to fruit during the course of their development many of them came in contact with and consumed the baits.

## POTATO-LEAF HOPPER

The work of the past year on the potato-leaf hopper, conducted cooperatively with the Wisconsin Experiment Station, has borne out earlier experimental results in showing that the use of Bordeaux mixture gives higher potato yields than that of the copper-lime dust. It seems to be the consensus of opinion among the growers, however, that even though spraying is superior to dusting, the greater ease and quickness of dusting greatly outweigh the advantages of spraying.

## GENERAL VEGETABLE INSECTS

## CULTIVATED LAND WIREWORMS

Work on the cultivated land wireworms has been continued in Washington in cooperation with the division of cereal and forage insect investigations, and in California. In order to reduce the cost of soil fumigation with hydrocyanic-acid gas, it has been necessary to concentrate the wireworms by baits, and later to treat the baited rows with the calcium cyanide, from which the gas is evolved. Such baits as peas, beans, and corn attract the wireworms readily. Under satisfactory soil and temperature conditions, a large proportion of the wireworms can be attracted to baited rows from 2 to 6 feet apart, in from 2 to 10 days, the actual percentage of worms attracted decreasing as the width of the rows increases.

It appears that about 90 per cent of the wireworms were attracted to rows 3 feet apart. Under average

conditions, 6 pounds of calcium cyanide to 1,000 feet of row is considered an efficient dosage. Biological studies are under way at the Washington laboratory in an attempt to discover some of the factors responsible for field infestation.

## PORTO RICO MOLE CRICKET

Poisoned baits have given the most satisfactory and economical control of the mole cricket under both cultivated and sod-land conditions. The principal experiments of the past season were conducted on the golf course at Brunswick, Ga., which afforded entirely different conditions from those found in cultivated lands. The poisoned bait gave excellent control and the infestation was reduced to the point where practically no injury could be observed during the fall and winter. By incorporating molasses at the mill, the composition of the bait has been changed slightly to obviate fermentation. The improved bait appears to have better lasting qualities, and does not require the addition of water before application.

## PEPPER WEEVIL

During the winter of 1924-25, adults of the pepper weevil hibernated in southern California, but owing to the high temperatures which occurred during the winter, active adults were found throughout the winter and spring. Cage tests with both calcium arsenate and sodium silicofluoride have given promising results in controlling the weevil, and under field conditions the use of these materials practically doubled the yield of sound peppers.

## CELERY LEAF TYER

Work on the celery leaf tyer in cooperation with the Florida State Plant Board has been undertaken in Florida. A careful experiment in determining the arsenical residue found on the celery plants at harvest time following treatments with various arsenicals was conducted with the Bureau of Chemistry. A study of the natural enemies of this insect in Florida and their effect on its seasonal abundance is now under way.

## SUGAR-BEET INSECTS

In cooperation with the experiment stations of several of the Northwestern States an intensive study of the desert



breeding grounds of the sugar-beet leaf hopper was undertaken, the principal object being to discover the stimulus responsible for the migration of the insect from its desert breeding grounds to cultivated beet fields. It has been discovered that the leaf hopper does not migrate from the desert breeding ground if suitable food is available in its desert environment, and the osmotic concentration of the sap of its food plants has been shown to give an index of the suitability of such plants as food. A number of stations for the study of the weather have been established over the desert areas adjoining the beet regions in southern Idaho and the information thus gained has proved of great value in connection with studies on the behavior of the insects under desert conditions. Careful laboratory work has developed a technique for feeding homopterous insects artificially, and it is expected that by the use of this method it will be possible to determine several troublesome points in connection with the transmission of plant diseases by insects.

#### BERRY INSECTS

##### STRAWBERRY WEEVIL

Sulphur-arsenical dusts gave good weevil control but burned the tender strawberry foliage in some tests. No insecticidal injury was noticeable to either bloom or fruit. Bordeaux-arsenical dust gave about as good control of the weevil as the sulphur-arsenical dust and produced no injury to the plant. It was found that the dust was more effective when applied to dry plants than when applied to wet plants, since apparently a better covering is obtained when dry plants are treated. These remedies for the weevil were used by growers on approximately 160 acres at a total cost for material of about \$800, resulting in an estimated saving to the growers of about \$24,000.

##### BERRY-MOSAIC TRANSMISSION

In cooperation with the Bureau of Plant Industry, investigations were inaugurated last season leading to the determination of the status of the various bramble-infesting insects in the transmission of three serious and obscure filterable-virus diseases affecting chiefly the red and black raspberries in the United States, that is, the red raspberry mosaic, the streak disease, and the mild mosaic.

Pure cultures of aphids free from infection by these diseases have been established and a pedigreed collection of infected plants harboring the viruses of these diseases is available for the production of virulent aphids.

#### PHYSIOLOGICAL INVESTIGATIONS

In cooperation with the University of Pennsylvania a series of quantitative studies was undertaken on the effect of arsenicals on insects. This work was necessary in order to make available a more accurate measure of the toxicity of the various poisons to the various groups of insects. It has been found that different arsenicals vary in their effect on insects, and also that these arsenicals affect differently young and old insects. Apparently trivalent arsenic as it occurs in the arsenical is more toxic to insects than the pentavalent form.

#### STUDIES OF ARSENICAL RESIDUES

In addition to the work on celery in Florida, studies of the arsenical residues on other vegetables are being conducted in cooperation with the Bureau of Chemistry, and it is hoped that as a result of these investigations it will be possible to make spraying recommendations which will be entirely safe from the arsenical-residue standpoint, and thus assure the grower that his products, if protected from insects, will be entirely safe for market.

#### INSECTS AFFECTING TOBACCO

Wireworms continue to be an important pest of tobacco in the Burley region about Lexington, Ky., an average of more than 50 per cent of the plants being attacked where tobacco follows sod. Investigations made during the year indicate that poisoned baits are much more effective for these insects when applied to freshly harrowed ground than when applied to a crusted soil. Under the favorable conditions as described above, a reduction of more than 90 per cent of the wireworm infestation has been achieved.

The tobacco Crambus (*Crambus caliginosellus* Clem.) continues to be a pest of major importance in the dark-tobacco belt of western Virginia. In years of severity the loss may amount to from 15 to 20 per cent of the crop, totaling more than \$1,500,000 for the belt. In years of lighter infestations the loss amounts to about 5 per cent of the crop, totaling around \$350,000.

This loss is brought about by infestations of early settings, necessitating one or more replantings, the first of which is frequently almost a complete resetting. A great decrease in yield and quality results. At the Virginia tobacco experiment stations, at Chatham and Appomattox, the loss has been estimated to amount to about 14 per cent annually. The experiments at Appomattox during the planting seasons of 1925 and 1926 resulted in a reduction of from 50 to 65 per cent of the crambid injury by one application of poisoned bait, at a cost of about 1 per cent of the crop value.

Years ago a method was devised for the control of tobacco hornworms and the remedy made available to the public through bulletins. During the present fiscal year data have been collected which suggest the possibility of an entirely new method of control for these pests. Amyl salicylate has been found to be a powerful attractant to the hornworm moth and experiments are under way to determine the feasibility of using this chemical to attract the moths to a poisoned bait before they have deposited their eggs upon the tobacco.

#### INVESTIGATIONS OF INSECTS AFFECTING COTTON

This work has been carried on under the immediate direction of B. R. Coad.

##### COTTON-BOLL WEEVIL

The extreme drought of 1924 extended through the cotton-growing season of 1925 and resulted in a very light infestation of weevils in most of the Cotton Belt during 1925. For this reason much of the work dealt with a check-up of various control measures under conditions of comparatively light damage as far as the boll weevil was concerned. Commercial use of poison was decidedly limited by the shortage of weevil infestation and instead of increasing in extent as has been the case each season for a number of years back, the area treated was apparently more or less the same as that of the preceding season.

In connection with boll-weevil control, special attention was devoted to a study of the width of "swath" possible with various types of dusting machinery in the effort to increase this wherever feasible to permit greater acreage capacity for the machines. Dust applications were made under all kinds of conditions with representative series of machines varying

from the smallest to the largest, and the amount of material adhering to the cotton plants as well as the width of spread was determined. This was then checked against the width of the weevil-control area and also the area in which cotton-leaf-worm control was accomplished. This work is not yet completed but evidently it is going to be possible to recommend certain of the newer types of machinery for wider swaths than were considered possible in the past. For several years there has been considerable public interest in the so-called cloud-drift method of dusting, under which the machines blow out a large quantity of dust and this is allowed to drift down wind across the field. The tests so far are rather discouraging, indicating that there is little likelihood that this method will be safe beyond a narrow limit. The relationship between various types of dust and the results of these tests has been given special attention.

In conjunction with the foregoing studies, special observations have been made on the relation between the adhesion of poison and varietal characteristics of cotton plants. For example, certain varieties are very hairy, whereas others are practically hairless.

The weevil-hibernation studies mentioned in preceding reports have been continued on an even larger scale. In the fall of 1925 hibernation cages were installed at 16 points scattered throughout the South from Texas to North Carolina. These tests were conducted, as a rule, by the State experiment stations and in the spring the weevil-emergence results were reported to the Tallulah office at bi-weekly intervals. Before the emergence actually started, a series of mass examinations were made throughout the South, one for the purpose of determining the number of weevils entering hibernation in the fall, and the other to determine the survival at the end of the winter. All of this information has been embraced in a series of reports issued at regular intervals. With the completion of emergence in the hibernation cages, these same cooperators inaugurated a series of biweekly reports on general cotton-insect conditions, which are issued in the same manner as the earlier reports.

The investigations on attracting the boll weevil by utilizing constituents of the cotton plant have continued as before and certain dilutions of trimethylamine and ammonia have proved



to be attractive to the weevil in laboratory tests. Field observations are now under way to determine whether or not the attractiveness of these materials can be increased to the point where they can be made of practical use.

The investigations of various types of dusting machinery have shown considerable progress. Commercial airplane dusting in 1925, although somewhat handicapped by lack of full information on the subject, showed the practicability of this method and as a result there are now several commercial airplane-dusting companies operating on a very extensive scale. Evidently several hundred thousand acres of cotton will be dusted in this manner during 1926. The experimental work has dealt largely with improvements in the mechanical devices for distributing the dust as well as improving the technique of dusting.

In the ground-dusting machinery especial attention has been devoted to the development of motor-operated, high air-velocity machines. These machines have the advantage of dusting more rapidly, requiring less dust for an effective covering, and also of being able to operate under adverse atmospheric conditions where the ordinary types can not make a satisfactory application. Several commercial companies are now interested in this new design and some test models built by them are in course of field trial. It is expected that these will be on the market for the season of 1927.

The relation between the exact chemical nature of calcium arsenate and its effectiveness in insect control is being studied very thoroughly. Chemically pure calcium arsenates of the various possible types have been made, and manufacturing conditions influencing their production have been studied. These arsenates have been tested against the weevil and other cotton insects to ascertain their relative values, and their effects on the cotton plant have been studied. It is anticipated that out of this series of studies a calcium arsenate much improved in both chemical and physical qualities can be evolved.

The program of work at the Florence, S. C., cooperative station has now been considerably modified. The experiments on various control methods under Southeastern conditions were carried through a three-year period and have now been closed and the results published. At present the only investigations of the bureau under way at Florence are the intensive

biological studies on the boll weevil. In these especial attention is being devoted to the seasonal occurrence of different generations of weevils as well as the migration habits of the weevil. Evidently information of great importance in practical control methods is to be derived from this series of observations.

#### ARIZONA WILD-COTTON WEEVIL

This insect has assumed greatly increased importance. Some 15,000 acres of cultivated cotton in the Santa Cruz Valley became infested during the past season. The biological investigations that were being conducted at the same time gave further proof of the ability of this weevil to thrive on cultivated cotton. It shows very important differences from the ordinary cotton boll weevil. It is able to withstand much higher temperatures, and hibernation investigations during the past winter showed a survival of approximately 75 per cent as contrasted with a survival of under 5 per cent which is usual for the ordinary boll weevil. The potential importance of this pest in case of introduction in the arid and semiarid areas of cotton production can hardly be overestimated and every effort is being made to prevent such spread if possible. Federal quarantines are now being enforced to prevent movement from the infested area. Intensive scouting is under way to determine the extent of infestation in the cotton fields, and a systematic scouting of the mountain ranges is being conducted to work out the complete distribution of this variety in nature. Special studies are being conducted to determine the feasibility and possible cost of some type of clean-up of the insect in nature as a possible permanent solution of the problem.

#### OTHER COTTON INSECTS

The cotton leaf perforator, which has been known to attack cotton in the arid sections of the West and particularly in the vicinity of the Imperial Valley of California, has been doing increasing damage each year and it was estimated that the damage in the Imperial Valley in 1925 ranged from 15 to 30 per cent of the crop. For this reason, a new station has now been opened at Calexico, Calif., and complete biological and control studies are being conducted to determine the exact extent of injury by this species and the possibility of its control.



The cotton-flea-hopper investigations have been greatly enlarged. Studies for several years at Port Lavaca, Tex., showed clearly the destructive capacity of this pest. Furthermore, in 1925, sporadic outbreaks of this damage were encountered at various places in the Cotton Belt extending as far east as Georgia and South Carolina. For this reason, a summary of all work which has been conducted was prepared during the winter of 1925-26 and an intensive experimental program outlined for the season of 1926. This has been greatly expanded, for in the early spring of 1926 an outbreak of this species developed over almost the entire Cotton Belt, causing rather serious damage. Apparently a fair degree of control can be achieved by the proper use of dusting sulphur, and several circulars giving instructions for such operations have been issued. It has now developed that the damage is apparently due to some form of disease or toxin transmitted by the insect and that, instead of a single species, a number are involved in causing this injury. The various species and host-plant relationships of all of these are under investigation. In Texas it has been found that the horsemint and croton plants are the important alternate hosts, but in other sections new plants are found. For example, in much of the central South the evening primrose becomes an important host plant. The flea-hopper problem is a very serious one and much intensive study will be required for its solution. Investigations are under way to determine the exact nature of the toxin or disease transmitted by the insect and the possibility of at least reducing the damage by indirect control measures such as field and ditch clean-ups.

The cotton leaf worm continues increasingly active and studies on this subject are made each season. Careful watch is maintained for the first occurrence of the worms in the extreme southern portion of the Cotton Belt and the progress of the different generations is then followed so that the farmers can be given due warning of expected invasions. This is proving especially valuable in enabling them to locate poisoning material in advance of the actual need. Special studies are being conducted to determine the relation between wind conditions and the direction of migration of the leaf-worm moths. This is accomplished by a series of releases of hydrogen-filled balloons.

The problem of weevil and leaf-worm control, of course, has many interrelationships and special studies have been made for the purpose of working out the most profitable dusting program in dealing with a situation in which both insects are involved.

The interrelationship between boll-weevil control and cotton-louse damage is an important subject of investigation. It has been found that the increase in louse infestation following calcium-arsenate dusting is a reaction to the mechanical killing of certain parasites and occurs only when these particular species of parasites are the dominant control factor. It has been found that it requires about three applications of calcium arsenate, made at short intervals during the absence of rain, to induce an injurious degree of louse infestation. At the same time, a method has now been evolved by which 2 per cent of nicotine can be added to calcium arsenate and applied for louse control with very satisfactory results, provided the application is made at a time when the air will remain practically calm for at least 30 minutes after the application is completed.

Observations on other cotton insects, such as the bollworm, grasshoppers, and various caterpillars, have been continued as usual, and farmers have been given the best advice possible for meeting local outbreaks as they occur. Such additional information as is possible is gained in each case.

#### INVESTIGATIONS OF INSECTS AFFECTING THE HEALTH OF MAN

The bureau acts as a center for information regarding medical entomology and has a very large correspondence with medical men, sanitarians, and the medical officers of the Army and Navy, and is in close cooperation on such subjects with the United States Public Health Service. The principal research work of the year has been devoted to mosquitoes and malaria and upon the skin malady known in portions of the South as "creeping eruption."

#### MALARIA AND MOSQUITOES

Investigations were continued at Mound, La., on the biology of malaria mosquitoes and methods of control in the alluvial lands of the Mississippi Delta, under the direction of W. V. King. Department Circular No. 367 was issued giving the results of pre-

liminary work in the use of airplanes as a means of distributing mosquito larvicides over large swamp areas, and a short supplementary report was issued later providing information as to the cost of such operations and their practical application.

The cooperative work with the department of immunology of the Johns Hopkins School of Hygiene and Public Health on the identification of the blood meals of mosquitoes, as a means of determining the host relationships and preferences of the various species, was brought to a close and the results of the large number of precipitin tests performed have been partially analyzed in preparation for a final report on the completed studies.

A report was published covering recent observations on the rate of emergence of adult *Anopheles* from natural breeding places and showing the relation of larval abundance to the number of adults produced per unit of area. New data were also presented showing the proportion of sexes emerging under natural conditions.

For several years past systematic observations have been made on the relative importance of the various types of breeding places in the production of *Anopheles* and the conditions favorable or unfavorable for their development. This has necessarily included a study of the larger aquatic vegetation and its relation to mosquito-breeding areas. These studies have been extended during the year by an investigation of the smaller aquatic life associated with *Anopheles* larvæ. This is done to determine the food requirements of the larvæ and will include studies of the abundance and seasonal distribution of the various plankton groups, especially the algæ, and their correlation with larval incidence.

The very unusual and prolonged drought of last summer interrupted the tests of airplanes in the treatment of breeding areas with Paris green. In the early part of the season, however, considerable additional information was acquired as to the practical application of this method, from a number of tests made on a prolific breeding area of about 800 acres. The effect of the drought in destroying aquatic vegetation was such that even after the swamps again became filled with water during the winter breeding has been very light and scattered during the 1926 season and the dusting experiments have not been resumed.

Laboratory work on larvicides has been continued and a large series of arsenical and other compounds, including certain proprietary products, have been tested out comparatively. The peculiar variation in susceptibility of *Anopheles* larvæ to poisoning with different arsenicals has brought up an important chemical problem as to the nature of the toxic effect of such products as Paris green, to which they are highly susceptible. Some studies have been made as a preliminary to further investigations.

Several conferences were held with members of the Public Health Service in regard to the feasibility of employing airplanes and Paris green in the control of *Anopheles* in various areas in the Southern States impounded for hydroelectric purposes. Another conference was held with members of this service and with the medical and other officers of the Marine Corps at Quantico, Va., with regard to mosquito control at this post. The breeding areas in the vicinity of Quantico were surveyed and recommendations made as to the use of airplanes under the conditions found there.

An unusually severe outbreak of salt-marsh mosquitoes along the entire Gulf coast during 1925 attracted widespread public attention and led to demands for an investigation of the problem. A rather brief survey of conditions along the coasts of Louisiana, Mississippi, and Alabama disclosed the seriousness of the situation and also the fact that almost no information was available as to the source of the mosquitoes or the extent of the area involved.

#### CREEPING ERUPTION OF MAN

During the preceding fiscal year the malady known as creeping eruption, which is very prevalent in the South, especially in Florida, was shown by the bureau to be caused by a larval nematode worm. As it seemed desirable to determine whether insects serve as vectors for this nematode, or as intermediate hosts, further studies were carried out during the fiscal year just ended. In this connection further epidermological studies have been made and various mites and insects prevalent in the situations where the human-infesting nematode abounds were studied and their nematode parasites cultured. No conclusive evidence has been gained, but much information necessary to a proper understanding of the problem has been collated. This work was



done by W. E. Dove and G. F. White in collaboration with J. L. Kirby-Smith.

### INVESTIGATIONS OF INSECTS AFFECTING DOMESTIC ANIMALS

This work has been carried on under the supervision of F. C. Bishopp with headquarters at Dallas, Tex.

#### SCREW WORM

Investigations relating to the screw worm, which is responsible for heavy losses to the livestock industry of the Southwest, constituted one of the major projects during the year. Studies of the reaction of the screw worm and other blowflies and the house fly to various chemicals were continued. Numerous tests were carried out under laboratory conditions to determine the relative attractiveness for flies of various baits, particularly liver of various ages and prepared in various ways. These tests seemed necessary in an endeavor to eliminate some of the variables which appeared to be affecting the results of the chemotropic exposure tests as carried out heretofore. For this same purpose further tests have been made of the spacing of the jars and the relation of sun, wind, and other factors which seem to influence the tests. A number of the more promising repellent substances were tested in varying dilutions, and some of them were found to be of little value as repellents or even to become attractive when diluted with neutral carriers. A large series of tests of some of the best repellents were carried out under range conditions. The materials were applied to wounds on animals which had become infested with screw worms. The effect of the repellent on the condition of the wound, the duration of the repellent effect, and the rapidity of healing of the wound were carefully noted in each case. A special grade of pine-tar oil with a specific gravity of 1.065 was found to be most satisfactory as a wound dressing when the various factors mentioned above, as well as cost and availability, were considered.

In cooperation with County Agent W. R. Nisbet, of Menard County, Tex., an extensive range-control project was put on against the screw worm. The various recommendations made by this office were followed in the work, but major attention was given to the operation in a systematic way of fly-traps on a large number of ranches. The results of the work during the

spring of 1926 were very encouraging. The number of screw-worm cases as well as the number of cases of the infestation of sheep by wool maggots was held very low at a nominal cost, whereas ranchmen not in the control area suffered serious losses.

#### CATTLE GRUBS

Further information was obtained during the year regarding the distribution of the two species of cattle grubs in the United States, particularly as regards their seasonal occurrence. During the winter and spring of 1926, L. I. Case, of the Virginia Experiment Station, followed a plan of control promulgated by the Bureau of Entomology for the cooperative control of the cattle grub in Burks Garden, Va. During the season practically all of the 2,300 cattle in this valley were treated five times at approximately monthly intervals. The average number of grubs per animal was found to be about 35 for the season. Farmers in the district reported very little annoyance to their cattle from heel flies following the control work. In this area the production of high-class beef cattle is the principal industry, and the cattle grub and heel fly have been found to interfere seriously with the growth and fattening of the animals.

#### THE CONTROL OF FLIES ABOUT DAIRIES

Studies were made during the year with a view to the development of a program for the control of the principal flies which cause annoyance to dairy animals and are responsible for the contamination of dairy products. A number of factors in this program received separate consideration, but the results of the entire system of control were best demonstrated in the cooperative work carried on with the Bureau of Dairying on the Beltsville, Md., farm of that bureau. In this work an effort was made properly to care for the manure and other materials likely to breed flies. Spraying of the animals with pyrethrum extract was practiced with fair regularity, fly-traps were operated, and fans and other means of preventing the entrance of flies into the creamery were used. In this very practical test it was found that a satisfactory degree of control of the house fly, horn fly, and stable fly was secured.

#### SHEEP SCAB MITE AND GOAT LICE

In cooperation with Texas Experiment Substation No. 14 work was continued throughout the year on this



project. Longevity tests with scab mites under varying conditions were continued, and the maximum longevity off the host was found to be 31 days. The tests of the length of time during which scab infestation may remain active in pens after scabby sheep have been removed showed that the pens did not remain infective in these tests more than a few days. Dipping experiments against the sheep scab mite and goat lice were continued but much additional work is necessary before conclusions can be drawn.

#### **INTERNAL MEDICATION FOR THE CONTROL OF EXTERNAL PARASITES**

The experiments begun last fiscal year with the administration of various materials to fowls to determine their effect on external parasites have been completed and the results are soon to be published. Much attention has been directed to the use of salt containing sulphur to protect livestock from the attack of flies. Although this method of procedure is scientifically unsound, it seemed necessary to conduct tests to obtain definite evidence on the subject. These tests show conclusively that the use of sulphurized salt has no effect whatever on the infestation of stock by horn flies, stable flies, or house flies.

#### **INVESTIGATIONS OF INSECTS AFFECTING FOREST AND SHADE TREES**

This work has continued under the direction of F. C. Craighead. No new projects have been undertaken, though continued pressure and demands for assistance from the Gulf States and the southern Rockies show the urgency for field stations in these regions. Western timberland owners are continuously demanding the extension of our services in California and Oregon. Excellent cooperation from private timberland owners, large-scale manufacturers of wood products, and affiliated associations, the United States Forest Service, and the National Park Service has enabled us to conduct investigations that would otherwise have been impossible.

##### **INVESTIGATION AND CONTROL OF WESTERN BARK BEETLES**

Technical administration of several control projects and examinations and surveys as a basis for recommendations as to control and continued research on the bionomics of several species of *Dendroctonus* formed the major activities in this work.

#### **THE SOUTHERN OREGON-NORTHERN CALIFORNIA PROJECT**

During the season of 1925 the fifth annual survey of this extensive project, covering 1,200,000 acres, was completed, bringing to date the results of the control work carried out during the preceding four years by private owners and State and Federal agencies. These results were even more gratifying than was anticipated. Although the season of 1924 was extremely dry, therefore favoring an increase in the destructive beetles, the losses were materially held in check on the treated units. The natural increase amounted to 97 per cent on the untreated area and to only 27 per cent on the treated sections. The total volume of timber saved as a result of these operations is estimated at approximately 50,000,000 board feet. The average cost was only \$2.77 per thousand feet, whereas the stumpage values in this region are from \$5 to \$7 per thousand. The total expenditures for control work to date on private and Government lands have amounted to about \$130,000.

The detailed management and technical analysis of the results of this large project, really amounting from our standpoint to a large-scale experiment, have developed some very valuable information as to the technique and administration of control as well as much of scientific value on the bionomics of the insects. Some of the more outstanding results as reported by F. P. Keen, who directed the work, are, "that the administration of control is more economical on smaller units than by large blocks as first undertaken in this project; that the influence of control is extremely local and does not extend to more than 1 mile from the area treated; that fall and winter treatment give better results than spring work; and that the most beneficial results from control were obtained on units where treatment was conducted against an increasing epidemic." The effects of treating endemic infestations seem to be overshadowed by other factors. In this region an epidemic status is placed at 65 trees per section. Many private owners in this region have been so impressed with the excellent results that they are considering control operations as of the same importance as fire control. In other words, the timber is being cruised annually and wherever an epidemic condition exists control work is immediately undertaken.

#### THE KAIBAB NATIONAL FOREST AND GRAND CANYON NATIONAL PARK

Further control work on this area was conducted in 1925. On the north end of the epidemic area the Forest Service spent some \$5,000. In the extreme south on Greenland Plateau—an isolated area within the Grand Canyon National Park—an expenditure of between \$4,000 and \$5,000 by the National Park Service was required. At present the general situation is very good. A very marked decrease in this epidemic occurred last year. The new infestation following the 1925 flight of beetles is estimated at about 3,000,000 board feet—a reduction of over 85 per cent from that which existed the preceding year. This marked decline can be attributed in part to control measures though by far the most important influences were natural agencies. A careful analysis of the factors bringing about this decline points emphatically to unusual weather conditions existing during the summers of 1924 and 1925. The extremely high winds during May and June of 1925 caused thorough desiccation of the infested trees, resulting in high mortality in the maturing larvæ.

During the late summer of 1925 a survey of the results of the previous years' control work was made. It was found that a reduction of 78 per cent was obtained on treated areas whereas adjacent untreated sections increased 73 per cent. There is every reason to believe that had funds been available to treat the entire infestation in any one year, the epidemic could have been effectively checked.

#### BITTERROOT CONTROL PROJECT

This project was started in May, 1925, in an effort to check the spread of an epidemic of the mountain pine beetle which has been sweeping south along the west side of the Continental Divide since 1910. Heretofore the losses have been confined chiefly to inaccessible stands but the insects now threaten merchantable timber. Recently the advance of this epidemic reached the headwaters of the Bitterroot River where over 200,000,000 board feet of yellow pine and lodgepole pine has been destroyed in the last three years. During the season of 1925 a limited amount of control was attempted, over 8,233 trees having been treated at a cost of \$7,535. The effect of this work was intangible, as the number of trees treated was not

sufficient to make much of an impression on this heavy infestation. Because of the value of the timber at stake a more extensive program was initiated in 1926 which it is hoped can be continued until the epidemic is under control.

#### INDEPENDENCE CREEK PROJECT

This project was instituted in 1924 on an experimental basis, having as a primary objective the testing of the effectiveness and economics of control of the mountain pine beetle in white pine. Control measures were carried on during the seasons of 1924 and 1925 and will be continued for at least two more years. Even though the infestation was increasing, a reduction of 60 per cent of the previous year's loss was achieved as a result of the first season's work, which more than justified the expense of the operation.

#### RELATION OF INSECT LOSSES TO FOREST MANAGEMENT

A survey was made during the summer of 1925 of 14 selected cut-over areas on national forest lands in district 5. The results of this study show that on certain sites bark-beetle losses take a heavy toll of the trees left for seeding of the area and for increment for a second cut.

An analysis of the growth rings of some 3,000 trees indicates that the western pine beetle shows a tendency to select the more slowly growing trees. This applies to the trees left on cut-over areas as well as to those in virgin stands. This discovery has opened up the possibility of eliminating the trees susceptible to insect attack through selective logging operations and through marking in timber-cutting operations.

#### INTERRELATION OF INSECTS AND FIRES

A further study of the extent to which bark beetles may supplement the damage caused by fires in western yellow pine forests has been made on the Northfork burn which occurred on the Sierra National Forest in 1924. This burn covers 6,000 acres, representing a variety of conditions caused by the fire. A thorough survey has been made of the entire burn and the surrounding area, sample plots were established, and over 4,000 infested trees marked and mapped. The results which will be available in 1927 will show the extent of insect damage in each of several types of injury due



to the fire. These studies are supplemental to others carried out in southern Oregon in 1918 to 1920.

#### COOPERATION WITH THE NATIONAL PARK SERVICE

For some years the bureau has been cooperating with the National Park Service by extending technical advice, making examinations of insect depredations, and occasionally detailing entomologists to assist on the more serious problems. During the fiscal year cooperation was established on a much firmer and more comprehensive basis by means of a transfer of \$4,000 from the National Park Service to this bureau. This enabled the bureau to provide additional personnel to take charge of and direct the control work on several serious infestations which developed the preceding year.

In the Yellowstone National Park some 7 miles of roadway was sprayed to protect the bordering lodgepole pines from defoliation by a sawfly and needle tyer. The sprayer was loaned by the gipsy moth laboratory of this bureau. Most satisfactory results were obtained, the sprayed area contrasting very strikingly with the adjacent untreated timber behind. Some 50 square miles of lodgepole pine forest has been almost completely destroyed by the combined attack of these two insects but the outbreak is now subsiding and prompt control measures saved the most frequented portions of the infested area.

In the Crater Lake National Park control operations were conducted against an increasing infestation of the mountain pine beetle. Approximately 4,000 trees were treated. The results of this work were most gratifying, showing a marked reduction in the infestation. On the greater part of the area practically complete control was obtained and only a small portion will need recleaning in 1926.

Cooperative control was likewise conducted against the Black Hills beetle in the Grand Canyon National Park. A more detailed account of this work is reported under the Kaibab control project.

A small but serious infestation was reported from the Devils Tower National Monument in Wyoming. Prompt control measures were conducted under the supervision of the Northern Rocky Mountain Field Station and it is hoped that complete protection will result.

#### COOPERATION WITH PRIVATE TIMBERLAND OWNERS

Each year the bureau is called upon by private timberland owners for more assistance in making examinations of beetle-infested timber and recommending proper control procedure. Several projects of this character were undertaken covering a total of nearly 100,000 acres and treatment of some 10,000 trees.

**PANDORA DEFOLIATION.**—In the last annual report attention was called to the increased bark-beetle attack in western yellow pine defoliated by the Pandora moth. During the past season it was possible to collect more concrete data on this interrelation. A private company holding timberland in this defoliated region became alarmed at the increased number of dying trees and instituted control measures. It was found that there was a direct correlation between the amount of timber killed and the percentage of defoliation. J. E. Patterson reports: "On the areas receiving 80 or more per cent defoliation in the years 1919 to 1924 there was an average of 80 trees attacked per section by bark beetles, some sections running as high as 300 trees. In the adjacent timber just out of the defoliated belt the bark-beetle infestation did not exceed an average of 40 trees per section. The results from control under these conditions can not as yet be foretold."

#### INSECT PROBLEMS IN THE SOUTHEAST

Late in the year the temporary field base established at Asheville, N. C., to study in more detail the several important forest insects in the Southeast was put on a permanent basis with the appointment of an assistant entomologist. Through arrangements with the Appalachian Forest Experiment Station we are using their field laboratory on the Pisgah National Forest. Several permanent sample plots have been established for the more detailed study of environmental factors contributing to epidemics of the southern pine beetle and of the interrelations of insects and forest fires. Valuable biological data pertaining to the southern pine beetle and associated insects were obtained during the season of 1925. More evidence supporting the incidence of these beetle outbreaks and drought has been obtained. The phenomenal increase of the southern pine beetle during such periods is partially explained by



demonstrating that with favorable conditions four and possibly five generations may occur during the season in this locality with a potential increase of nearly 1,000 per cent in each generation.

The insect problems associated with turpentine and reforestation in the Gulf States received some attention.

#### WHITE-PINE WEEVIL

The undertaking of a new project for the investigation of the white-pine weevil in the Northeast, made possible by contributions from private timberland owners, was reported last year.

Much of the field season was spent studying the various parasites and predatory enemies and a number of species were collected and determined. Several hundred leaders collected from various localities were caged in order to get some information on the species common in the various localities. Direct control was carried out in a number of plantations. All the leaders weeviled in 1925 were removed and either caged or burned. In other plantations many of the trees were coated in various places with sticky tree-banding material. These experiments will be carried further this year. The possibility of indirect control of the injury through proper forest management has been studied very fully, but much work remains to be done. Many permanent and semipermanent sample plots have been laid out in various ages, sites, and mixtures, and on different exposures. From the information already obtained this phase of the study bids fair to be of paramount importance in finding adequate means of preventing the injury.

#### INVESTIGATIONS IN THE LAKE STATES

The most important problem handled from the St. Paul field station during the year has been the tip-moth studies in the Forest Service pine plantations at Halsey, Nebr. This eastern tip moth (*Rhyacionia frustrana* Comst.), accidentally introduced into these plantations, has been causing enormous damage. Investigations have proceeded along two lines; one, an attempt to develop a method of treating nursery stock so as to prevent the dissemination of the moth into new areas; the other, aimed at controlling the present infestation through the introduction of parasites. Several effective dips for nursery stock have been experimentally tested. About 20 species of parasites have been introduced and it will be several

years before it can be determined if these will become established.

The spruce budworm and jack pine sawfly have received attention in northern Minnesota. The hemlock looper is reported very injurious in some portions of Wisconsin.

#### INSECTS AFFECTING FOREST PRODUCTS

Tests of wood preservatives for both crude and finished forest products, as well as poisons for wood-pulp products, have been continued both at Falls Church, Va., and on Barro Colorado Island, Canal Zone, Panama, by T. E. Snyder. Woods treated with various metals by the United States Bureau of Standards, using a machine in which metal wire is run through an electric arc by compressed air, have not lasted well in service tests in contact with the ground in Panama. Because of the contraction and expansion of the wood, the metal chips off and the wood is attacked by termites. In the case of such treatments for cabinet work, furniture, etc., indoors, conditions might be more favorable for success.

Some of the test woods impregnated by the Forest Products Laboratory of the Forest Service with sodium fluoride, alone and in combination with other chemicals, have been attacked by termites after one year's test in the ground in Panama. Treatments with such soluble salts would probably be more effective as preservatives for interior woodwork not in contact with the ground where moisture causes them to leach out.

A series of woods impregnated with war-time chemicals supplied by the United States Chemical Warfare Service are under test.

On recommendation of this bureau a large public-service corporation in southern California has recently purchased 10,000 poles impregnated for their entire length with coal-tar creosote to prevent termite damage in a region where the whole pole is subject to serious damage by termites.

Preliminary tests indicate that termites which live above ground and do not burrow in the earth (Kalotermitidae) will not attack untreated fiber or composition wood-pulp boards. If so, this will be a great advantage, since wood with a grain, if used untreated as interior finish, is badly attacked by termites.

Model or demonstration "termite-proof" buildings are being constructed on Barro Colorado Island, Canal Zone, Panama, and at New Orleans, La. These buildings are constructed en-

tirely of woods impregnated with various chemicals, and the interior finish is treated fiber board. They are being used in connection with the educational propaganda for such slight modifications of city building regulations as will prevent losses from termite damage, with the especial purpose of protecting the small householder.

Manufacturers of implement handles made of seasoned hardwoods are adopting the Bureau of Entomology's recommendations to paint their products, thus overcoming the trade prejudice for white sapwood and enabling the use of heartwood which is not attacked by powder-post beetles and is just as suitable when of the same grade as the sapwood.

A survey of defects in timber caused by insects and their relation to the conservation of timber, especially hardwoods, indicates that much of this damage can be prevented, and that closer utilization of "sound wormy" timber will aid in forest conservation.

Orthodichlorobenzene continues to be effective in killing borers and powder-post beetles in woodwork and furniture.

Biological work is being conducted with reference to subspecies or subraces of *Reticulitermes*, the most destructive genus of termites in North America and Europe. Breeding experiments within the species and by hybridization are to be undertaken. Studies of symbiotic Protozoa are also to be made in both Europe and North America.

#### INSECTS AFFECTING SHADE TREES AND HARDY SHRUBS

Investigations of the boxwood leaf miner have been continued and expanded somewhat through cooperation with the Bureau of Plant Industry of the Pennsylvania State Department of Agriculture, the Andorra Nursery Co., and estate owners. A molasses-nicotine spray has been tested in the neighborhood of Washington and fumigation work carried on near Philadelphia. The effect on both insect and plant has to a considerable extent been determined although the results of these investigations will not be ready for publication for at least another year. In most infestations by the boxwood leaf miner, especially those of several years' duration, the plants have been considerably devitalized and a disease which is normally secondary becomes of primary impor-

tance. The Federal Bureau of Plant Industry has been giving this disease some attention.

Through the cooperation of S. M. Dohanian of the gipsy moth laboratory a shipment of *Tetrastichus xanthomelaenae* Rond., a small hymenopterous parasite of the eggs of the elm leaf beetle, were obtained for liberation on the Taylor estate at Gordonsville, Va.

#### BEE-CULTURE INVESTIGATIONS

The work of the bee-culture laboratory has been continued under the supervision of James I. Hambleton.

##### BEHAVIOR OF BEES

The determination of the brood-rearing activity of various foreign races of bees has been carried on to ascertain particularly any difference existing between the various races in their propensity to breed out of season in this country. Experimental work on queen rearing, begun last year, has been continued.

Computations are being made of data collected on the Delaware coast during 1925, where an experimental apiary was established. This apiary had access only to an artificial honey flow, and it is hoped that the data will throw some light on the reaction of bees to weather factors alone.

A continuous recording automatic scale, carrying a colony of bees, has been installed at the laboratory. The most minute changes in weight of the colony, as affected by weather factors and other outside stimuli, are continuously recorded on a moving chart. This instrument will give a curve of general colony activity for the entire year.

Experiments started last summer regarding the reactions of bees to intensities and colors of light are being continued. The spectral filters in use are being standardized for three factors; wave length of light transmitted, actual energy transmitted (i. e., intensity), and stimulating effect of each kind of light on the bee's eye. After having done this it will be possible to plot a curve showing the relative sensitivity of a bee's eye to light of various colors. By attempting to train the bees to associate food with a certain wave length of light as against another wave length of the same stimulating efficiency, it may be possible to ascertain whether they can actually distinguish colors, or are color blind, a point much in dispute.



The work on the color grading of honey was finally completed by the issuance of Department Circular 364, The Color Grading of Honey. In cooperation with the Bureau of Agricultural Economics further work on the grading and standardization of practically all classes of commercial honeys has been done during the year. It is hoped that much confusion concerning the classes and grades of honey will be done away with by the adoption of classes and grades as recommended in a forthcoming publication.

Shortly after the beginning of last fiscal year investigations were started on certain phases pertaining to methods of managing colonies of bees during the fall. Experience indicates that if colonies are in what appears prime condition in the fall, but slight loss is entailed during the winter and little attention need be given them the following spring. The purpose of this experiment is to ascertain just what factors should be present in the colony during fall to insure strong colonies for spring. Spring and winter losses, resulting from faulty management of colonies during the fall, amount to hundreds of thousands of dollars annually.

#### PHYSIOLOGY OF BEES

During the past winter three gross analyses of the disemboweled bodies of worker bees were made with a view of determining some of the exact physiological changes taking place in the body of the bee during its quiescent period. It is during this period that heavy losses of colonies occur over the entire country. One of the results of the analyses showed, contrary to expectations, a gradual increase in the ether extract content in the body of the worker bee from December to March.

In cooperation with the Bureau of Home Economics preliminary studies are being made of the food value of honey. The present phase of the work deals largely with the vitamin content of extracted honey. Feeding experiments in this connection are being done on white rats and guinea pigs.

#### DISEASES OF BEES

Department Circular 284, The Sterilization of American Foulbrood Combs, was issued in March. This circular, of a technical nature, gives the results of sterilization with various materials of wax combs containing spores of American foulbrood. It was found that a 20 per cent solution

of formalin in water was efficient and cheap for this purpose. A further study along this line is being made of the loss of formalin from the water solution during the sterilization process.

An attempt has been made to culture *Bacillus larvae* directly from infected honey. Even when the honey is infected to an unusual degree it is exceedingly rare that success is attained. In this connection, the detection of spores of *Bacillus larvae* in honey has been accomplished by means of ultra filters. This method is yet too expensive to justify hope for its adoption as a routine method of detecting commercial honeys infected with spores of *Bacillus larvae*.

In the routine diagnostic work on bee diseases 784 samples of brood and adult bees have been examined. There is no evidence of falling off in the number of samples of either American foulbrood or European foulbrood, the two most serious brood diseases of bees. In the examination of adult bees no cases of infestation by *Acarapis woodi* have been found.

Work the past year dealing with the relation of fungi to honeybees has brought to light five species of *Aspergillus* actively pathogenic for adult bees and brood, and three others pathogenic for adult bees, the pathogenicity of these latter for brood not having been determined. One of these apparently undescribed organisms appears to have been the cause of an epidemic in a Connecticut apiary. At least two other species and genera of fungi collected from bees have been found to be pathogenic for adult bees. An active toxic substance, for honeybees, has been extracted from a pathogenic species of *Aspergillus*. The nature of this toxin has been partially determined.

#### BEEKEEPING REGIONS IN THE UNITED STATES

Lack of funds has prevented doing the most desired work on this subject, although specific information is being constantly gathered concerning the principal honey-producing regions of the United States. Much field work needs to be done to collect all the data wanted.

Through the cooperation of some 2,000 correspondents, who are being trained in reporting the blooming dates of honey plants, floral isophanes for the principal nectar-producing plants are being worked out.



### DEMONSTRATIONS IN BEEKEEPING

As this office has no field representative, little active work has been done on this project. This, in turn, has been a handicap, as it leaves the office correspondence as the only means of liaison between the office and the field. To overcome this to a certain extent various members of the staff have attended meetings of beekeepers in the field. Twenty-five such meetings were attended.

### INSECT-PEST SURVEY

The work of the insect-pest survey has been carried on as in the past under the direction of J. A. Hyslop.

The survey has now functioned five years and is recognized as an integral part of the cooperative work of the bureau and the entomological agencies existing in the several States and the Dominion of Canada.

During 1925 the survey completed volume 5 of its Monthly Bulletin, consisting of 8 numbers and 397 pages of text material, and an index of 40 pages. Numbers 1 to 4 of volume 6 were also issued during the fiscal year, comprising 123 additional pages of text material. Urgent material was handled in the form of special reports as heretofore.

Additional work on the common-name index instigated by the survey and assumed by the American Association of Economic Entomologists has been carried on, and a supplementary list to the one published in 1925 was presented to the association for its approval. This work will be continued through the current year.

The work on the correlation of climatic conditions with the abundance of the chinch bug has advanced but little during the past year because of the ever-increasing mass of material which the survey is handling.

The survey still contemplates incorporating in its files all the statistical data on economic insects of North America which have been published in the past. Of course the scope of this work is so great that it can not be attempted until the technical force of the survey is augmented. This same condition exists with relation to the atlas of economic entomology and the host-plant index projected in previous reports.

The survey files now contain references to over 1,900 species of insects reported as of more or less economic importance. These insects represent practically all the major orders and

fall into 1,356 genera. The ratio of new pests to those already reported is of course diminishing each year. Our files are rapidly becoming representative of the economic entomological situation in North America and additional names in the future will be largely those of unusual pests or introduced species.

The cooperation with the States is as enthusiastic and complete as possible. The number of collaborators has increased from 55 in 1921 to 71 on July 1, 1926.

The demand for the Survey Bulletin as a means of keeping closely in touch with the entomological situation throughout the country, by entomologists, extension workers, teachers, produce exchanges, and general science services has greatly increased.

### TAXONOMIC STUDIES OF INSECTS

The accurate identification of the insects on which the experts of the bureau are working is a matter of prime importance and therefore there has grown up gradually in the force a corps of specialists in the various groups of insects. These specialists are of high authority in the field of entomological science and their judgments are absolutely dependable. Therefore the workers on economic problems are soundly based by these men as to exact identities and group classification.

The mere identification of the species sent in from the field by bureau workers, by the Federal Horticultural Board, by the workers in the State experiment stations, and by collaborators at home and abroad is an enormous labor. But this is not all. Every one of these workers is a research man who produces and who is at work constantly on the study and description of species new to science and in the preparation of monographic papers for the use of entomologists everywhere.

To systematize the administration of this class of work it has been made a division of the bureau with S. A. Rohwer in charge. From his report for the fiscal year it appears that nearly 10,000 species were identified during the year from 5,800 lots sent in. The larger part of this work, it should be stated, was for the Federal Horticultural Board, which bases its important decisions upon these identifications. The research work done by these taxonomists in addition to this has been very large and of a high character.







Released

Saturday, November 1, 1926

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EXPERIMENT STATION FILE

## REPORT OF THE CHIEF OF THE OFFICE OF EXPERIMENT STATIONS

UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF EXPERIMENT STATIONS,  
*Washington, D. C., September 1, 1926.*

SIR: I have the honor to submit herewith the report of the Office of Experiment Stations for the fiscal year ended June 30, 1926.

E. W. ALLEN, *Chief.*

Hon. WILLIAM M. JARDINE,  
*Secretary of Agriculture.*

The Office of Experiment Stations continued, without material change during the year, its work of administering the Federal funds granted to the State experiment stations for promotion of research in these institutions; supervising and directing the work of the agricultural experiment stations in Alaska, Hawaii, Porto Rico, Guam, and the Virgin Islands; supplying a current review of agricultural research throughout the world, in Experiment Station Record; and, in general, serving as a clearing house of information and aid for the experiment station enterprise as a whole.

The work of the office was increased in volume, and partly in kind, through the operation of the Purnell Act, which went into effect at the beginning of the year and increased by \$20,000 the Federal funds for station support in each State for the year.

### INCREASED ENDOWMENT OF THE STATIONS

The \$1,440,000 provided by the Hatch and Adams Acts (\$30,000 for each State) for the State experiment stations was increased at the beginning of the year by \$960,000, provided by the Purnell Act (\$20,000 for each State), making a total of \$2,400,000 from Federal sources, which will be increased \$480,000 annually under the Purnell Act until it amounts to \$4,320,000 in the year ending June 30, 1930.

The States apparently accepted with practical unanimity the view that the

Purnell Act was not intended to relieve them of their financial or other obligations to the stations, and they have generally not only maintained but in some cases substantially increased their support of the stations. The total sum available for the use of the stations during the year was something over \$10,500,000.

### EXPANSION OF THE WORK OF THE STATIONS

The increased activity of the stations resulting from the use of the additional funds was reflected in an increase of the total number of research projects from 5,538 in 1925 to 6,300 in 1926, or nearly 14 per cent, and of the number of station employees from 2,530 to 2,754, or about 9 per cent.

The expansion of the work of the stations greatly increased the time and attention required on the part of the office in reviewing and passing upon projects, examining the work and expenditures of the stations, and in various other ways. This additional burden was carried without increase of assistance, the need for which, however, was recognized and provided for in the appropriations for the department for the fiscal year 1927.

### PURNELL PROJECTS

Something over 600 Purnell projects were reviewed and approved for the year. Of these, 20 dealt specifically with soils and fertilizers; 30 with field crop production, and pastures

and ranges; 35 with horticulture (20 fruits, 15 vegetables); 30 with plant diseases; 35 with insects and other pests; 75 with animal production (8 animal nutrition, 16 meat production in general, 6 beef cattle, 15 swine, 8 sheep, 22 poultry); 20 with dairying; 14 with animal diseases; 14 with agricultural engineering; 176 with agricultural economics, distributed as follows: Economics of production 36, farm management 33, marketing 78, taxation 21, miscellaneous 8; 18 with rural sociology; and 84 with home economics (foods 54, clothing 3, home management 27).

It will be observed that of the total number of Purnell projects, nearly one-half (278) deal with the less developed fields of research in agricultural economics, rural sociology, and home economics, evidencing a keen interest in the expansion of research in these fields. Of the increased personnel, 140 were investigators in agricultural economics and rural sociology and 81 in home economics.

### COOPERATIVE ENTERPRISES

The operation of the Purnell Act increased the volume and extended the scope of the work of the stations and at the same time enlarged and strengthened the cooperative relations between the department and the stations, between the stations, and within the stations, thus fully justifying the expectation that it would awaken new interest in cooperative research.

The department and the stations are now cooperating in more than 500 formal projects and in a large number of less formal ways. The development of cooperation has been especially marked in the lines of economics, home economics, and meat production.

The selection of a limited number of national problems for cooperative study, namely, distribution and marketing and disposition of surpluses of farm products, the functioning of rural social organizations and agencies, rural home management, factors affecting the quality and palatability of meat, and the vitamin content of foods in relation to human nutrition, and the setting up of joint committees of the department and the stations to aid in formulating these cooperative projects and encouraging participation in them, have done much to enlarge the already extensive cooperative relations of the stations and the department.

The work of these committees cleared through the chief of the office, as executive secretary, and has been of substantial aid in coordinating and

correlating the research projects submitted to the office for approval.

### POLICY WITH REFERENCE TO USE OF PURNELL FUNDS

Out of the preliminary conferences and discussions and a year's experience in administering the Purnell funds have emerged certain fairly well-defined rules and principles which it is generally agreed should control in the use of these funds:

(1) All work is to be done on approved projects mutually agreed upon by the stations and the department.

(2) The fund is for new work or for expanding or putting new force into work already in progress. The Purnell Act specifically provides for increased work in economics, sociology, and home economics, but does not exclude work in production or other lines.

(3) The increase of funds provided by the act in no way relieves the States of their financial or other obligations to the stations, and should be used only for such overhead charges as relate directly to the support and conduct of definite projects.

(4) The act calls for clear-cut concrete proposals for sound investigation in accordance with modern conceptions and present knowledge, of such number and scope as can be studied in a comprehensive, thorough, and conclusive way with the means available and combined to form a systematic, well-rounded research program, enlisting as far as practicable cooperation within the stations and with other stations and the department.

### DIVISION OF INSULAR STATIONS

The administrative supervision of the agricultural experiment stations maintained by this department in Alaska, Hawaii, Porto Rico, Guam, and the Virgin Islands has continued to be performed by Walter H. Evans, of this office.

No changes were made in the policies of the various stations during the year. Each station is endeavoring to develop a type of agriculture suited to the local situation in the hope that its adoption will result in a more prosperous and contented citizenship. The stations do not desire to conflict with established industries but rather to supplement them through the greater diversification of agriculture in the various countries. In doing this they are cooperating in many minor enterprises that appear to offer promise of



success when once established. While the objectives of their work are the improvement of their respective communities, some of the results of their investigations have wide application and have been put into practice in similarly situated countries in other parts of the world.

The only income of the several insular stations is the annual appropriation made by Congress, and this has been so inadequate that some important lines of work have been suspended and others continued under very adverse conditions. The number of appointed employees—and this includes all the technical staff—was three less in 1926 than in 1920. The total appropriation was but 8.8 per cent greater, whereas the salary roll showed an increase of 21 per cent, due almost entirely to reclassification, and the labor roll, with fewer employees, showed an increase of 28.6 per cent by reason of the higher wages paid. Personnel expenses took 79.6 per cent of the total appropriation in 1926. Maintenance and operating expenses have increased proportionately, and the only way by which the stations have been able to continue has been through the reduction of expenditures for equipment and upkeep of property. Prior to 1916 the stations were permitted to use the proceeds derived from the sale of products. These sums were carefully conserved, and at most of the stations they were used for the erection of buildings or other permanent improvements. At the present time practically every station is in need of more buildings to properly house the employees and their work.

With the passage of the Purnell Act the Federal contribution to the support of experiment-station work in the several States was doubled for 1927. This has permitted the State stations to extend their lines of work and increase their personnel. The insular stations are trying to do for the agriculture of their communities what the State experiment stations are doing for theirs. Aside from a few industries, the agricultural situation in the several insular regions is as acute as it is anywhere, and it is hoped that more favorable consideration will soon be given to the needs of the insular stations.

The total incomes of the several stations for the fiscal year ended June 30, 1926, were: Alaska, \$76,240; Hawaii, \$54,940; Porto Rico, \$56,460; Guam, \$20,860; and Virgin Islands, \$22,180. In addition, the Guam station was permitted to expend \$3,847.50, the balance

of the special appropriation for coconut-scale control. Proceeds from sales amounting to \$6,395.68 were deposited in the Treasury as miscellaneous receipts.

#### ALASKA STATIONS

Owing to the inability of maintaining the stations as formerly, the Rampart station was closed at the end of the crop year and the movable equipment was transferred to the Fairbanks station. The herd of cattle at the Kodiak station had increased to such an extent that it became impossible to produce the necessary forage for winter feeding, and all the stock included in the dairy-breeding experiments was transferred to the Matanuska station, where conditions are believed to be more advantageous for their maintenance. E. M. Floyd, who had been in charge of the Rampart station for several years, was transferred to the Kodiak station in March, 1926, and W. T. White, superintendent of the Kodiak station, was sent to the Matanuska station as associate animal husbandman. Hans Lindberg, horticulturist at the Sitka station, resigned December 31, 1925, and E. A. Eggersluess was appointed to succeed him on May 1, 1926.

Weather conditions for crop production were unusually favorable over most of Alaska. A mild winter was followed by the early disappearance of the snow, and the soil was dry enough for plowing by the middle of April. The rainfall was light in the interior valleys during the early summer, but it was sufficient to produce average crops.

The culture of improved hardy strawberries originated by the station was extended. Practically all of the strawberries grown in Alaska for market or domestic use are of varieties originated at the Sitka station.

Some of the stations' improved seedling potatoes were produced in sufficient quantity for testing in other parts of the Territory. One of these varieties yielded, at the Matanuska station, at the rate of 322 bushels per acre, the highest yield obtained in a comparative test of 16 seedling and commercial varieties.

The results of further experiments in growing tulip and narcissus bulbs indicate the possibility of increasing the bulbs for planting purposes and give promise of successful bulb growing in the Territory.

The growing of Jerusalem artichokes for feed and forage proved



highly successful at the Sitka station. Good growth was also obtained at the Matanuska station in the interior, but the tubers were not winter hardy there.

With a frost-free period of 128 days, yields of 30 bushels of wheat per acre, 20 of barley, and 40 of oats were obtained at the Matanuska station. Tests of 8 varieties of early maturing corn at this station resulted in failure to produce grain. At the Fairbanks station, with a frost-free period of 95 days, 8 days less than the average, yields of 26.7 bushels per acre of Siberian No. 1 wheat, 30 bushels of Finnish black oats, and 22.5 bushels of Hybrid No. 19 barley, a hull-less variety, were obtained on a field scale. Higher yields were obtained from small plats. All of these varieties are of station origin.

The Yak-Galloway crosses are proving vigorous and hardy, but their value as beef or milk animals remains to be determined.

The Alaska stations are badly in need of buildings, equipment, and cleared land for experimental purposes and pastures. The office and residence building at the Fairbanks station is scarcely habitable. A larger barn is needed at this station to care for the livestock and provide storage space for plant-breeding experiments. The Matanuska station is in immediate need of additional barn space and cleared land to provide for the greatly increased herd of dairy cattle.

#### HAWAII STATION

The work of the Hawaii station, particularly along its agronomic and horticultural lines, was affected by an unprecedented drought.

The station is quite active in developing its cooperative work with homesteaders and others through the distribution of agricultural and horticultural planting material. This not only introduces new and improved crops to the planter but gives the station valuable data that otherwise would be very slow in being accumulated.

The station has continued its efforts toward the diversification of the agriculture of the Territory, and as a result of its investigations with the pigeon pea and edible canna considerable areas of both crops are being planted on the various islands. Neither crop competes in any way with sugar-cane and pineapple growing, and they offer opportunity for considerable extension of the agricultural output of the islands. Experi-

ments of the station have shown that some of the less productive sugar-cane lands can be so enriched by the growing of pigeon peas as to make the production of sugar cane more profitable than before. Stockmen are also greatly interested in the pigeon-pea crop on account of the large yields of highly nutritious feed.

Extension work continues to be an important feature of the station's activities, and it is unable to meet all the demands for this service. The extension agent on Hawaii traveled more than 10,000 miles during the year in visiting farmers, schools, and clubs interested in agriculture. He superintended extensive plantings of various kinds and gave considerable time to problems connected with the marketing of farm products.

The leader of the boys' and girls' club work reports an active season. Clubs of various kinds have been established on all the larger islands, except on Molokai. The total enrollment for the year was 1,320, 81 per cent of which completed the program and submitted reports on their work. This work is increasing in popularity, and although the club leader gave 75 per cent of her time to field work, she was unable to keep up with requests for the organization of more clubs. Extension work with adults was carried on, and a number of very successful clubs were organized among the women.

The Haleakala substation and demonstration farm on the island of Maui continues to be an important factor in the agricultural development of that homestead region. It is finding crops adapted to that elevation, and a large amount of planting material was supplied to neighboring homesteaders. In addition, the superintendent was active in promoting club work and garden contests on Maui. This substation is conducted in cooperation with Territorial officials.

The Hawaii station is in need of an additional chemist to carry on analytical and experimental work on a number of important problems and an assistant in extension to develop the field of club work that is giving such excellent results.

#### PORTO RICO STATION

The lines of work of the Porto Rico station were not changed to any extent.

Ever since the station was established the importance of improving the livestock of the island has been stressed, and by the use of purebred

Guernsey bulls it has bred up a dairy herd that now consists of fifteen-sixteenths Guernsey blood. Some of the grade cows have produced more than 5,000 pounds of milk a year. Preliminary experiments have shown it is possible to produce Swiss, Cheddar, and Edam cheese of good quality under Porto Rican conditions. It has been found that breeding stock introduced from the States must be well fed and protected from the sun during the hottest part of the day. When these precautions are observed, cattle can be introduced with safety in regions that have been cleared of cattle ticks. In connection with its livestock work the station has found that certain introduced forage plants are superior to native varieties. The planting of the introduced varieties is being widely extended.

The station is giving much attention to the breeding of sugar cane, and more than 100,000 seedlings were produced during the past year. This number has been reduced to a few thousand for further testing. One variety developed by the station, that combines high sugar yield with resistance to the mosaic disease, is being widely tested.

Chemical and physical studies of pineapple soils have shown that attention must be paid to the soil reaction for the profitable production of the crop. Acid soils or those below neutrality, if well flocculated, are best suited to pineapple growing in Porto Rico.

The plant pathologist extended his investigations on the bud rot of coconut. He found that the common hat palm of Porto Rico is even more susceptible to the disease than the coconut. In cooperation with insular authorities a campaign has been begun for control of the disease by the destruction in burning of all infected trees. A destructive anthracnose of pigeon peas and a *Phytophthora* boll rot of cotton were discovered during the year.

The Porto Rico station is in need of an enlarged scientific staff. A chemist, an animal husbandman, and an entomologist should be added to the staff. These positions have been vacant from 3 to 12 years. The station has the equipment for all these positions, and there are many problems needing solution that can not be undertaken on account of the lack of men.

#### GUAM STATION

The Guam station, with its limited personnel and resources, is continuing

its work along the same lines as previously reported.

On account of its importance much attention was given to the coconut-scale situation. A number of parasites and predacious enemies of the coconut scale were found, and every possible effort was made to secure their wide distribution. The introduction of other parasites was seriously impeded by the isolation of Guam and lack of adequate transportation facilities. The abundance of the scale seemed greatly reduced at the end of the last rainy season, and it is hoped that a balance between it and its enemies can be established. Parasites of the cottony-cushion scale, mealy bugs, and aphids have been introduced from Hawaii, and the cottony-cushion scale has been greatly reduced by the parasites wherever established.

On account of the lack of a trained agronomist the field work in agronomy has been confined almost entirely to investigations of introduced forage plants to determine their value under Guam conditions.

The work with livestock has been limited to breeding-up experiments with cattle, swine, and poultry, and feeding experiments to determine the value of coconut meal as a supplementary feeding stuff.

The horticultural work has been confined to maintaining the collections of fruits and vegetables and testing other introductions for their adaptability.

The Guam station is in need of enlarged personnel, more equipment, and additional land. It has been without an agronomist since June, 1921, although crop work is generally recognized as being of great importance. It has also been without an extension leader since November, 1921. The adult natives do not read publications and they have no means of learning of the station's work except as it is brought to them by demonstrations or otherwise and their interest aroused. Even then experience has shown the necessity of much follow-up work to induce any change in native methods.

#### VIRGIN ISLANDS STATION

Satisfactory progress is reported on all the projects of the station notwithstanding a deficient rainfall during the year.

The station is continuing its work with sugar-cane seedlings, and it has in the field about 2,000 seedlings produced in 1925, a great majority of which are from S.C.12/4, a variety developed at the station by the former director. This variety has been exten-



sively tested in the West Indies, and it has become one of the most popular varieties in Porto Rico, where it is extensively planted.

Following a successful experiment in 1925 in growing Bermuda onions for the New York market, a cooperative association of about 20 members was formed, and about 700 crates were shipped to New York in the spring of 1926, which netted the growers \$1.91 per crate to repay production costs. One grower raised 300 crates on 2 acres.

The sweet-potato-breeding work, in which more than 800 seedlings have been grown, was continued. One seedling is outstanding, combining large yield, good table quality, and attractive appearance.

The work with livestock, although of great importance, is handicapped by the lack of a trained animal husbandman and sufficient breeding stock. In its effort to produce more sanitary milk, the station has eliminated from its herd all cows that were accustomed to have their calves run with them until weaned and has thereby increased the yield and improved the quality of the milk produced.

The water-storage capacity of the station was increased by the addition of a 15,000-gallon cistern to receive the overflow from buildings. With this addition the station now has water-storage facilities of approximately 280,000 gallons, which appears to be ample for present needs even in a dry season like that of the past year.

In response to numerous requests for work in crop demonstrations on the islands of St. Thomas and St. John, arrangements were made at the close of the year for the transfer of the horticulturist, W. M. Perry, of the station, to St. Thomas, to have charge of cooperative and demonstration work designed to encourage the growing of vegetables and other crops for local use.

The Virgin Islands station needs additional scientific workers. The vacancy caused by the transfer of the horticulturist to St. Thomas should be filled, and an animal husbandman who can deal with problems of breeding, feeding, diseases, and marketing of livestock should be appointed. Cattle raising is second in importance to sugar production, and there are many problems to be investigated to place this industry on a sound basis.

## PUBLICATIONS

The publications of the office during the year differed little in volume or

character from those of the previous year. They included 37 documents, aggregating 3,424 pages, as compared with 40 documents, aggregating 3,057 pages; the previous year. There were issued the usual numbers and indexes of Experiment Station Record and a combined index of volumes 26 to 40 (1912-1919), as well as a list of abbreviations used in the Record, 5 bulletins and 6 reports of the experiment stations in Alaska, Hawaii, Porto Rico, Guam, and Virgin Islands, a revised personnel list of the experiment stations, 2 articles contributed by the Porto Rico Experiment Station in the Journal of Agricultural Research, a report on the work of the office for the year ended June 30, 1925, and a report on the work of the experiment stations for the year ended June 30, 1924.

## EXPERIMENT STATION RECORD

The largest single undertaking of the office in the way of publication is Experiment Station Record, which, with its 18 numbers and 2 detailed indexes annually and with combined indexes from time to time, furnishes an indispensable record of current progress in scientific research relating to agriculture throughout the world and provides in readily accessible form a repository of the best results of such research during the last 37 years. The Record condenses in less than 1,800 pages annually the essential features of approximately 9,000 articles, aggregating 410,000 pages, recording in various languages scientific research in agriculture in all parts of the world. This requires the examination of over 300 scientific and technical journals daily.

During the year volumes 53 and 54 of the Record were prepared for publication, each consisting of the usual nine numbers and an index number. The two volumes contain a total of 7,086 abstracts of the current scientific literature pertaining to agriculture, together with the customary monthly editorials discussing the promotion of agricultural education and research and related questions and brief notes in each issue on progress in these directions in this and foreign countries.

Beginning with volume 54, a number of changes in arrangement and classification of abstracts were adopted. The most significant of these was the addition of two new sections, textiles and clothing, and home management and equipment, which it was thought would provide more conveniently and logically for abstracts of the litera-



ture relating to the various branches of home economics.

The rapid increase of the literature of agricultural research has made it increasingly difficult to give an adequate review of it within the limits to which the Record is now restricted. The last enlargement, from 1,600 to 1,800 pages yearly, was made in 1911. Since that time the quantity of agricultural research worthy of review has increased greatly. This has created severe pressure for space for abstracts and is responsible for a congestion which has been steadily growing more serious for several years. An expansion of at least 200 pages of abstracts per year appears to be inevitable in the near future.

Two important bibliographical aids to the use of the Record were published during the year. One of these was a revised list of the abbreviations employed in the Record for the 3,600 titles of periodicals currently reviewed, the other a 640-page general index covering volumes 26 to 40, already referred to.

#### REPORTS ON THE WORK OF THE STATIONS

A report on work and expenditures of the experiment stations, 1924, published during the year, includes, as usual, a review of the progress of the stations; discussion of special administrative problems and relations of the office with the stations; information regarding personnel, projects, additions to buildings and equipment, State legislation affecting the stations, and publications; and detailed statements of income and expenditures, and other data. The report also contains a general review of some of the more important results of station work during the year, and special articles, with bibliographies, on home economics research, breeding work with field crops, horticultural breeding work, and research in animal genetics at the stations.

A similar report for 1925 was prepared and submitted for publication, which shows the status of the experiment station enterprise on the eve of the inauguration of the new work under the Purnell Act and at the beginning of what is believed to be a new era in agricultural research in this country, and indicates the need of the assistance which the Purnell Act was intended to supply.

These annual reports on the experiment stations assemble in convenient

form data otherwise widely scattered and undertake to discuss in a constructive way the problems, work, publications, and outlook of the experiment stations as integral parts of a national system of scientific research in agriculture. They therefore have a permanent as well as current interest and value.

#### BIBLIOGRAPHIC AND INFORMATIONAL SERVICE

Bibliographic and informational service in a broad sense is one of the chief means by which the office seeks to aid the stations and promote sound research. The largest service of this kind is, of course, rendered by Experiment Station Record, but such service is not confined to the Record. It takes the varied forms of reviews and compilations of information, bibliographies and lists of references on special topics of interest to station investigators, the preparation and issue of weekly, monthly, annual, and biennial lists of station publications, and contributions to the Official Record of the department.

The second biennial supplement to the list of bulletins of the agricultural experiment stations published as Department Bulletin No. 1199 was prepared and submitted for publication during the year. New features introduced in this supplement are author and subject indexes, which it is thought will make the information contained in the lists more readily available and increase their usefulness.

A timely piece of bibliographic work was the preparation of a revised and up-to-date table showing the distribution of vitamins A, B, and C in some 150 food materials and a selected list of references to literature on the subject. This compilation furnishes an index of the rapid growth of work on the subject of vitamins in this country and, it is believed, will be useful to research workers in the experiment stations as well as dietitians.

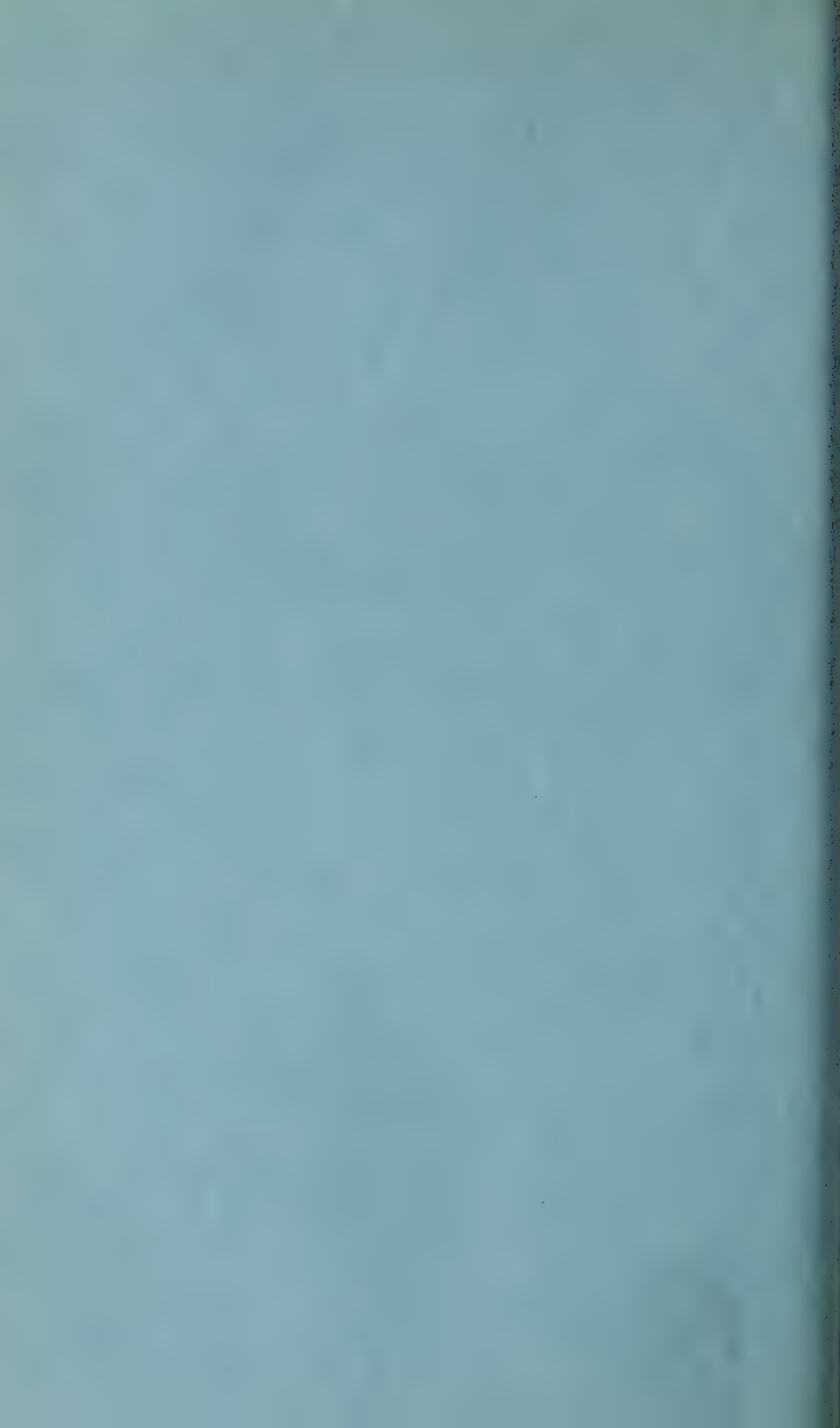
#### EXHIBIT AT PHILADELPHIA SESQUICENTENNIAL EXPOSITION

As a part of the Government exhibit at the Philadelphia Sesquicentennial Exposition, the office contributed a small exhibit illustrating certain features of the history of the development of the experiment station enterprise in this country, the character of the work of the stations, and the relations of the office thereto.









## REPORT OF THE DIRECTOR OF THE EXTENSION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE,  
EXTENSION SERVICE,  
Washington, D. C., September 25, 1926.

SIR: I have the honor to present herewith the report of the Extension Service for the fiscal year ended June 30, 1926.

C. W. WARBURTON, *Director.*

HON. W. M. JARDINE,  
*Secretary of Agriculture.*

### ORGANIZATION

The organization of the Extension Service has continued during 1926 without change, except that, by order of the Secretary, dated January 15, 1926, the office of agricultural instruction was officially made a part of the Extension Service. This small unit had previously been a detached unit in the office of the Secretary, although the funds for it were carried in the appropriation for farmers' cooperative demonstration work, one of the Extension Service items.

### PERSONNEL

The personnel in Washington on June 30, 1926, consisted of 170 persons, of whom 5 were employed in the office of the director, 113 in the office of cooperative extension work, 25 in the office of exhibits, 20 in the office of motion pictures, and 7 in the office of agricultural instruction. The field force on the same date consisted of 3,874 persons, of whom 3,861 were cooperatively employed by the department and the States in extension activities. The office of demonstrations on reclamation projects employed 2 persons in addition to those cooperatively employed with State extension services; 2 were full-time employees of the office of cooperative extension work, and 9 were employed by the office of exhibits. In addition to the persons employed cooperatively by the department and the States, more than 1,100 were engaged in extension work in the States who are not under appointment from the department.

### FUNDS ADMINISTERED

The direct Federal appropriation for the Extension Service during the fiscal year was \$1,645,704, of which \$1,308,540 was for farmers' cooperative demonstration work, \$148,779 for salaries and administrative expenses, \$99,745 for exhibits, \$38,640 for demonstrations on reclamation projects, and \$50,000 for farm-forestry extension. In addition, Federal appropriations amounting to \$5,880,000 were allotted to the States for extension work under the terms of the Smith-Lever and supplementary acts. The States, counties, and other agencies contributed \$12,526,047 for cooperative extension work. The total of all of these items, the sum available for extension work in the United States during the fiscal year, was \$20,051,391.

### COOPERATIVE EXTENSION WORK

#### PERSONNEL

The personnel of the office of cooperative extension work during the year has continued on practically the same basis as previously. C. B. Smith is chief of the office, with J. A. Evans as assistant chief. On June 30, 1926, the Washington staff consisted of 10 administrative or supervisory officers, 13 organization field agents, 11 subject-matter field agents, and a clerical staff of 83. This is an increase of 1 organization and 1 subject-matter field agent, as noted below.

During the year F. P. Lund, specialist in food preservation, has continued on furlough in Denmark, intro-

ducing American methods of extension work in agriculture and home economics, at the request of the International Education Board. J. A. Evans was engaged throughout the year in a study for the Portuguese Government of the possibilities of cotton growing in the colonial possessions of that country in southeast Africa, but is expected to return within the next few months.

At the urgent request of the agricultural colleges in the Eastern States, an organization field agent in boys' and girls' club work was appointed February 1, 1926. R. G. Foster, for several years assistant director of extension in Nevada, was selected for this position. Through arrangement with the Bureau of Public Roads, L. A. Jones was employed as subject-matter field agent in agricultural engineering.

The entire State field service on June 30, 1926, numbered 4,965 persons, an increase of 105 during the year. Of this number, 3,513 were permanently located in the counties, 2,221 being in county agent work, 882 in home demonstration work, 135 in boys' and girls' club work, and 275 in extension work with negroes. The county workers were supplemented by 764 full-time and 218 part-time subject-matter specialists located at the State agricultural colleges. There were 413 persons employed as supervisors and assistant supervisors, and the administrative officers and their immediate assistants numbered 57. These figures show an increase during the year of 66 county workers and 52 specialists, and a decrease of 13 administrative and supervisory workers. The increase in specialists was due in considerable part to the development of farm-forestry extension under section 5 of the Clarke-McNary Reforestation Act, funds from which were made available at the beginning of the year. Of the total, 3,861 were cooperative employees of the office of cooperative extension work, practically all engaged either in county work, supervision of county work, farm-management demonstrations, or farm-forestry extension.

### FUNDS

The total funds from all sources available for cooperative extension work during the fiscal year were approximately \$19,809,196, or about \$200,000 more than for the previous year. Of this amount 36.8 per cent, or \$7,283,149, was contributed by the Fed-

eral Government, exclusive of the use of penalty envelopes; and 28.1 per cent, or \$5,562,707, was derived from State appropriations to the agricultural colleges and other State agencies. The remaining 35.1 per cent, or \$6,963,340, came from county appropriations for extension work and from contributions by local organizations and individuals. About 93 per cent of all funds used for cooperative extension work in 1926 came from public sources.

Of the Federal funds \$5,880,000 was made available by the Smith-Lever Act and other appropriations supplementary thereto, \$1,353,149 from direct appropriations, and \$50,000 for cooperative farm-forestry work. Of the total funds, \$12,352,007 (62.3 per cent) was allotted for extension agents in the counties; \$1,124,216 (5.7 per cent) was allotted at the State agricultural colleges for administration; \$2,141,112 (10.8 per cent) for supervision of county extension forces; and \$3,878,172 (19.6 per cent) for the employment of subject-matter specialists to supplement the county workers. The remaining 1.6 per cent, or \$313,689, was for activities of the Federal Extension Service located at Washington.

### PROGRESS

#### RESULTS

Nearly 4,000,000 improved practices were reported adopted, due to extension influence on the farms and in the farm homes of the United States in 1925.<sup>1</sup> As compared with 1924, the chief increases in the number of practices adopted by farmers and home makers were in clothing, nutrition, house furnishings, horticulture, home management, foods, control of rodents and insect pests, and dairying. There were fewer new practices adopted in agricultural economics, animal husbandry, cereals, soils, and legumes and other forage crops. Progress in obtaining the adoption of improved practices was due in large measure to the successful demonstrations conducted by farmers and members of their families under extension supervision and to the active part taken by them as volunteer local leaders of extension work in their communities.

<sup>1</sup> All extension field reports are for the calendar year; hence figures contained in this report on cooperative extension work, except where the fiscal year is indicated, are for the year ended Dec. 31, 1925.



The number of demonstrations conducted by adult farmers and farm women in 1925 was 772,469, as compared with 645,488 in 1924. The number of demonstrations completed by farm boys and girls as members of 4-H clubs<sup>2</sup> was 589,440, as compared with 489,262 in 1924. Both with adults and with juniors an increase of over 100,000 demonstrations was reported over the previous year.

The largest increase in the number of adult demonstrations in 1925 over 1924 was in clothing, home management, house furnishings, nutrition, soils, potatoes, cotton and other special crops, and poultry.

#### LOCAL LEADERS

In 1925 more than 200,000 farmers and farm women assisted the paid extension staff as volunteer local leaders in the promotion of extension work. So important have extension demonstrators come to regard the aid given by these leaders that every effort is being made to help them to meet the requirements of such leadership. For this purpose some 27,887 State and county leader-training meetings were held.

More effective training for both extension agents and volunteer local leaders assisting them received marked attention from administrators and supervising officials. Numerous group conferences of supervisors, specialists, and county extension agents and special courses of instruction at some of the agricultural colleges were held for this purpose. The use and place in the programs of county extension agents and local leaders of such agencies for extension appeal as meetings, tours, campaigns, publications, circular letters, news items, exhibits, window and lobby displays, posters, motion pictures, lantern slides, radio, slogans, and dramas were given increased consideration. The systematic training of local leaders in writing news items for their county papers with the assistance of State extension

editors was a new and promising development in a few States. Recognized authorities from various college and university departments of education, journalism, commerce, business administration, psychology, and oral expression were brought into conferences of extension agents to discuss from every angle how and why the human mind acts as it does and to aid in the development of a sound philosophy of extension teaching.

#### PROGRAMS OF WORK

Of the 80,588 communities in the counties from which reports were received, 50,719 were reported as having programs of extension work determined by the extension agents in consultation with the local people. The year saw a further tendency toward the development of long-time agricultural programs in the States and counties. In many communities the holding of the annual meeting to decide on the local extension program for the year took the aspect of checking up the progress made on the long-time program of the community and determining what part of it should next be undertaken. Economic fact finding and commodity or enterprise studies were made and conferences held for counties, districts, and States to obtain a sound economic basis for long-time programs. Such studies were followed and conferences held in 1925 in eight of the far Western States and in some of the Eastern States. Membership by 759,443 farmers and farm women in local extension clubs or groups materially aided in carrying out the work planned.

#### ADULT ACTIVITIES

Leading the lines of agricultural activity given in order of the percentage of time devoted to them by extension agents were farm crops, poultry, animal husbandry, dairying, horticulture, soils, agricultural economics, rural engineering, rodent and insect control, and forestry. In marketing, the assistance of extension agents was sought more largely in aiding existing marketing organizations to get farmers to standardize their crops and grade them in accordance with accepted grades than as previously in establishing new organizations for cooperative marketing.

In home demonstration work demonstrations conducted by farm women increased 36 per cent over the previous

<sup>2</sup> 4-H clubs are organized and conducted by cooperative extension agents to aid in the teaching of better farm and home practices to boys and girls in order that they may keep in touch with the best in rural life and may develop leadership, community responsibility, and good citizenship. The symbol of the 4-H club is the four-leaf clover containing an H on each leaf, the clover signifying the purpose for which the first clubs were created—soil conservation. The four H's signify the four things that must be trained by the boy and girl to insure success in club undertakings—head, heart, health, and hands.

year. This was attributed largely (1) to the further stabilization of existing home demonstration clubs and other organizations of farm women for cooperating with extension agents and (2) to the increased responsibility accepted by volunteer local leaders in the promotion of the work. Clothing, foods, nutrition, home management, house furnishings, and home health and sanitation in the order named were leading lines claiming the time and attention of extension workers with farm women and girls. In addition to productive and management activities, opportunities for recreation and self-development were sought and created by farm women through their extension organizations. Numerous community and county recreational and social events, such as contests, camps, and pageants contributed to the enrichment of family and community life.

#### ACTIVITIES OF BOYS AND GIRLS

Local 4-H clubs for farm boys and girls to the number of 41,286 were in active operation. The enrollment of 565,046 boys and girls was 54,000 more than in 1924, with 58 per cent completing all requirements of the year's work. In completed demonstrations by 4-H club members, increases over the previous year were reported in clothing, house furnishings, foods, nutrition, potatoes, cotton and other special crops, and horticulture. The only decrease of any size was in home management. More than in any previous year attention was devoted to the health and growth of the boys and girls themselves. "Be your own best exhibit" was the slogan generally used by the 4-H health clubs.

The future of the 4-H club movement was given lengthy study by the State directors of extension, constituting the committee on extension organization and policy of the American Association of Land-Grant Colleges, and by representatives of the office of cooperative extension work. In this study it was found that only 1 out of 20 rural boys and girls between the ages of 10 and 18 is enrolled at present in 4-H club work. As a result of the study a program for the systematic development and expansion of 4-H club membership to make the benefits of such membership available to all rural boys and girls desiring them was adopted. As a part of this program plans were approved for holding a national 4-H club en-

campment of State club leaders, their assistants, and outstanding members of the 4-H clubs from each State, in Washington, D. C., in June, 1927.

A number of State supervisors of club work and extension agents gave special attention to developing organizations and activities for rural young people too old for the usual type of 4-H club work, yet not in a position to carry on demonstrations for adults. Young farmers' clubs and young people's community clubs or associations were started and met with considerable success in a number of counties.

#### MISCELLANEOUS

More than 18,500,000 persons attended 549,000 meetings arranged for or participated in by extension workers. Personal calls by the agents were made on more than 714,000 farmers and 232,000 home makers. Personal interviews with agents at their offices were reported to the extent of more than 3,000,000, together with more than 2,000,000 telephone calls. More than 3,767,000 personal letters were written in reply to requests for information.

The organization of the forestry projects under the Clarke-McNary Act, which began to function on July 1, 1925, received much attention in the States. At the end of the fiscal year 25 extension forestry specialists had been appointed under the act and were working harmoniously in cooperation with existing forestry departments and other agencies in the several States.

#### EXTENSION STUDIES

In addition to increasing its activities in conducting field investigations of various phases of extension as it is actually conducted in the field this unit of the office has continued to be responsible for summarizing the more than 4,000 annual reports of State and county extension workers, farmers' institute activities, and extension activities of foreign countries, the work being handled by M. C. Wilson, in charge of extension studies.<sup>3</sup>

#### FIELD STUDIES

With the close of the preceding fiscal year 5,898 farm and home records had been obtained in 11 counties of

<sup>3</sup> Owing to its increased field studies, the designation of this unit of the office was changed during the year from "reports and efficiency studies" to "extension studies."



six States in cooperation with the State extension services. During the year additional records were obtained in 10 counties of four States. Although the State extension services desired, in many cases, to make a general study of the effectiveness of extension in reaching rural people and of the factors influencing the adoption of improved practices, an effort was made to broaden the scope of the investigations. In Massachusetts a special study was made of junior extension. In New Jersey and South Dakota local leadership studies were conducted and information obtained regarding the influence of home demonstration work upon village homes. In Georgia and Arkansas the influence of extension upon negro farms and farm homes was also studied. In Wisconsin the alfalfa project received special attention.

These studies indicate that satisfactory progress has been made by the extension organization in reaching rural people, and they also point out clearly the remaining task of getting more farmers and home makers to accept extension teaching and to adopt improved farm and home practices. Considerable information was also made available regarding the comparative effectiveness of the various means and agencies commonly employed in extension teaching and the influence of such factors as size of farm, condition of land occupancy, distance from the extension office, participation in extension activities, and contact with extension workers upon the spread of improved practices.

On the basis of these studies, the following publications were prepared by the office and cooperating State extension divisions: Department Bulletin 1384, *The Effectiveness of Extension in Reaching Rural People* (combined report of field studies in Iowa, New York, Colorado, and California); mimeographed office Circular 2203, *The Effectiveness of 4-H Club Work* (based on field study in Massachusetts); Extension Service Circular 4, *Club Data from Extension Studies*; New Jersey Extension Bulletin 50, *Local Leadership and the Effectiveness of Extension Work in Reaching Rural People*; Georgia Extension Bulletin 319, *The Effectiveness of Extension in Reaching Rural People*; Arkansas Extension Circular 221, *The Effectiveness of Extension in Reaching Rural People*.

Conferences connected with the making of extension studies were attended

in Alabama (negro), Arkansas, Georgia, Illinois, Indiana, Iowa, and New Jersey. The Central States regional conference at Ames, Iowa, was also attended.

#### SUMMARY AND DIGEST OF REPORTS

The 4,000 annual reports of State and county extension workers were assembled and the usual statistical summary, Extension Service Circular 8, *Statistical Results of Cooperative Extension Work, 1925*, was compiled.

The same plan as in previous years was followed in indexing the narrative reports of State administrative and supervisory officers, State subject-matter specialists, and county extension agents. The digests of these narrative reports have steadily grown in favor with field workers. As a consequence more of them are being mimeographed, and the circulation is steadily increasing. Thirty-two subjects were covered, and of this number 13 were duplicated for distribution. Undoubtedly the best digest prepared during the year was on the copper-carbonate method of treating wheat for stinking smut, issued in cooperation with F. C. Meier, extension plant pathologist. Almost immediate use of the experience of county agricultural agents in 1925 with this method of seed treatment was made available in the spring-wheat areas. A second edition was run for use in the wheat-smut campaign in the winter-wheat areas later in the season. The digests published were on the following subjects: Exhibits, community buildings, better-sires campaigns, ton-litter contests (swine), cotton-production contests, landscape gardening, improved seed and varieties of cotton, junior dairy-calf clubs, child feeding, junior poultry clubs, control of cotton insects, cotton fertilizer, and copper-carbonate treatment for stinking smut of wheat.

#### FARMERS' INSTITUTES

Information regarding farmers' institutes conducted during 1925 was compiled by J. M. Stedman. The 16 States conducting institutes reported an aggregate of 2,750 institutes extending over a period of 4,286 days and comprising 8,942 sessions at which a total of 1,421,092 persons were in attendance. The cost of these institutes was \$146,820, of which \$86,863 came from State appropriations and \$59,757 from local sources.



## VISUAL INSTRUCTION AND PUBLICATIONS

Matters relating to visual instruction, publications, press material, radio, photographs, lantern slides, charts, motion pictures, exhibits, and other illustrative material were handled under the direction of Reuben Brigham, in charge of visual instruction and editorial work. Probably the outstanding developments in this field were the large increase in the use by extension workers of the standard glass lantern-slide service of the office, the beginning of a supplementary service of slide series on motion-picture film, and the large demand for field photographs for use in the department news service and by special writers.

### PUBLICATIONS

The following printed publications were prepared by the office of cooperative extension work and issued during the fiscal year: Cooperative Extension Work, 1924, with 10-Year Review. Department circulars: 343, Extension Work in Agronomy, 1923, by O. S. Fisher; 345, Farm-Forestry Extension, 1923, by G. H. Collingwood; 346, Extension Work with Fruits, Vegetables, and Ornamentals, 1923, by C. P. Close, W. R. Beattie, and F. L. Mulford; 347, Methods and Results of Cooperative Extension Work Reported through County Agricultural Agents, 1923, by H. W. Gilbertson and C. L. Chambers; 348, Boys' and Girls' 4-H Club Work, 1923, by I. W. Hill and Gertrude Warren; 349, Extension Work in Foods and Nutrition, by Miriam Birdseye; 355, Extension Work Among Negroes, by J. A. Evans; 375, An Extension Program in Home Management and Farm Management for the Western States, by W. A. Lloyd; Department Bulletin: 1384, The Effectiveness of Extension in Reaching Rural People, by M. C. Wilson; Miscellaneous Circular: 59, County Agricultural Agent Work under the Smith-Lever Act, 1914-1924, by W. A. Lloyd.

A series of mimeographed extension-service circulars was begun, to which the following contributions were made by the office of cooperative extension work: 1, State Extension Programs and Agricultural Research, by W. A. Lloyd; 2, The Extension Ladder, by W. A. Lloyd; 3, Methods of Extension Teaching, by H. W. Hochbaum; 4, Club Data from Extension Studies, by M. C. Wilson; 5, The Effect of Weather Conditions on Percentage of Moisture in Market Corn, by O. S. Fisher; 6,

Objectives, Methods, and Results of Home Demonstration Work, by Grace E. Frysinger; 7, Junior Poultry Clubs, by M. C. Wilson; 8, Statistical Results of Cooperative Extension Work, 1925, by M. C. Wilson; 9, Extension Campaigns, by H. W. Hochbaum; 10, Extension Work in the Newer Agriculture, by C. W. Warburton; 11, Comments on Extension Work in the North Central States, by C. B. Smith; 12, Selected List of Books for Use in 4-H Club Work, by Gertrude L. Warren; 13, Use of Fundamental Principles of Teaching in Extension Work, by A. B. Graham.

Extension workers made 10,530 requests for department publications, which were filled in cooperation with the office of information. About 212 pieces of duplicating were done for the office during the year by the office of information and 229 small jobs by the small emergency duplicating unit of the office.

### INFORMATION SERVICE

A steadily increasing demand for illustrated news material relating to cooperative extension activities, to be used in farm papers, magazines, and other news services, is shown in the larger amount of material requested and the wider distribution of these requests as compared with the previous year. Such news material relating to national and regional results and developments in extension work was collected and prepared to accompany 850 photographs of various phases of extension work, an increase in amount of about 70 per cent. More than one-third of the magazines and writers using the material made their initial requests during the year.

Cooperating with the department press service, the section prepared 298 articles relating to various phases of extension work for news use in the Official Record, the department clip sheet, mimeographed release, or other channels.

### VISUAL INSTRUCTION

At the request of State extension divisions, talks on photography and the preparation and use of visual material as applied to the extension field, followed by discussion and practical demonstrations, were given at conferences of extension workers in California, Colorado, Iowa, Kansas, Michigan, Missouri, Montana, Nebraska, Oregon, Utah, Washington, West Virginia, and Wyoming. Intensive work

in photography at district conferences of county extension agents in Kansas was particularly well received.

Observations on the organization and facilities for visual presentation were made in 9 of the States just mentioned, similar observations having been made in 11 other States in the previous year. These observations indicate the desirability of centralizing all visual presentation activities in State extension divisions. Such centralization conserves funds and the effort and time of specialists and other extension workers and tends to develop a standardized and uniformly high type of visual presentation.

#### PHOTOGRAPHIC SERVICE

In cooperation with State extension divisions several carefully planned series of field photographs illustrating extension work were obtained for use in publications, information service, and exhibits and for distribution in lantern-slide form. This photographic work was done in Connecticut, Florida, Illinois, Iowa, Kansas, Maryland, Missouri, North Carolina, Oregon, Utah, Virginia, Washington, and Wyoming, 1,752 new field photographs being taken.

The photographic reference file of the office includes illustrations on a wide variety of agricultural and home-economics subjects in constant use by department and field employees and cooperators. This file at the end of the year comprised 28,631 photographs, 3,134 new illustrations having been added during the year.

Nearly 34,000 negatives, prints, slides, enlargements, charts, posters, and drawings were requested and prepared for use in extension work. Requests for the preparation of illustrative material received for this section by the office of information included 2,914 negatives, 19,649 prints, 10,408 slides, 561 enlargements, and 393 miscellaneous items, inclusive of blue prints. In the section 2,308 lantern slides and 347 enlargements, posters, and photographs were colored for extension uses; 825 charts, drawings, and designs were also prepared.

#### LANTERN SLIDES

Distribution of sets of lantern slides lent to State extension divisions for field use increased largely, the number sent out being 2,028, as compared to 815 the previous year.

In cooperation with subject-matter bureaus of the department, 15 series of lantern slides were prepared for the use of extension workers on the following subjects: Care of the horse's feet; the nature of plant diseases; milk in the home; the farm wood lot; lime and limestone; nut-tree propagation; breaking the farm colt; better farm management for northeastern Montana; clover production; budding and grafting fruit trees; chestnut blight; what shall I wear; veterinary activities of the United States Bureau of Animal Industry; handling rough rice to produce high grades; clothes moths. The preparation of 13 other series of slides is in progress. The following series have been revised: Production of poultry and eggs; butter making on the farm; the production of alfalfa east of the ninety-fifth meridian; leguminous forage crops for the South; leguminous forage crops for the North; good roads; commercial potato production; green manuring; soy beans—culture and uses; the wheat crop; the farm water supply; farm sanitation; farm forestry in the South; the barberry-eradication campaign; 4-H camps for boys' club members; selecting the laying hen; farm manures; breeds of sheep; educational milk-for-health campaigns; analyze your business; quack grass; plant propagation; handling cotton—how to prevent weather damage; cotton-boll weevil; production of clean milk; range management on the national forests; plumbing for farm homes; food makes a difference; eradication of tuberculosis from livestock and poultry.

On May 1, 1926, the office of cooperative extension work announced a new service of lantern-slide series on motion-picture films, supplementing the existing glass lantern-slide series. The following series were prepared in cooperation with the subject-matter bureaus of the department and made available in this form: 34, green manuring; 103, the wheat crop; 104, the farm water supply; 105, farm sewage and sanitation; 126, selecting the laying hen; 131, farm manures; 133, standard varieties of chickens; 141, breeds of sheep; 142, judging hogs; 147, control and reparation of cullies; 150, how to get rid of rats; 156, analyze your business; 158, quack grass; 160, handling cotton; 165, the nature of plant diseases; 166, cotton-boll weevil control; 174, milk in the farm home; 184, 4-H



camps; 189, plumbing in the farm home; 196, clover production.

#### MOTION PICTURES

In cooperation with the office of motion pictures, four extension motion pictures were completed as follows: Poor Mrs. Jones, From Ranch to Ranch in California, John Doe's Cotton and Yours, and The Short Course.

#### EXHIBITS

In cooperation with the office of exhibits, extension material was prepared for the interstate boys' and girls' club exhibit at Sioux City, Iowa, and for the Sesquicentennial Exposition at Philadelphia. In cooperation with the extension service of New Jersey an exhibit was prepared for the biennial convention of the General Federation of Women's Clubs at Atlantic City.

#### RADIO

At the request of the Bureau of Agricultural Economics a questionnaire was sent to county agricultural agents in 1925 to determine the extent to which farmers are interested in radio and the uses to which they are putting it. A study of the 1,086 questionnaires returned indicates that 309 county agricultural agents had radio sets in their office or at home, and that an estimated total of 220,634 radio sets were owned by farmers in the counties reporting, or an average of about 204 per county. From these figures, the Bureau of Agricultural Economics estimated that about 553,000 radio sets were owned by farmers in the United States. The data from the questionnaires indicate a considerable increase over last year in interest and knowledge of the uses of radio on the part of county agricultural agents and farmers.

The office contributed to the new department radio educational service established by the office of information, such contributions being largely made by the subject-matter specialists of the office to the questions and answers department.

#### SUBJECT-MATTER SPECIALISTS

An agricultural engineer was added to the corps of subject-matter extension workers during the year, bringing the number up to 11. The work

has continued under the general charge of A. B. Graham.

One purpose of these workers is to organize the investigational results of the several bureaus of the department into form for use by the extension services of the several States. The subject-matter specialists, in cooperation with the investigational forces of the bureaus, determined the means and agencies by which the results of research may best be extended. They also assisted in preparing publicity and other general information for extension use. Five members of the staff prepared material for the mimeographed periodicals entitled "The Extension Pathologist," "The Extension Animal Husbandman," and "The Extension Horticulturist," which set forth the methods advocated by the department and those in use by State specialists. By these and other means the best extension methods were made available to all workers. The specialists also reviewed all projects submitted by the States which related to their particular line of work. In their visits to the States they gave further study, through personal observation, to extension methods, agencies, and plans. Where funds were not yet available to employ a subject-matter specialist, certain persons within the bureaus were designated to give particular attention to plans, surveys, and reports of extension work related to bureau activities. In some instances these specialists have prepared annual reports on extension work in their subjects for publication.

The extension subject-matter specialists attended the various subject-matter regional conferences. In December, 1925, the extension plant pathologists attended a conference on extension work at Kansas City, Mo., held under the auspices of the American Phytopathological Society, to study the general problem of plant-disease control and methods of teaching the use of economic controls. In January, 1926, a national conference of extension foresters was held in Washington, D. C., to bring together the subject-matter specialists working on a comparatively new project that they might get the viewpoint of the department regarding forestry extension, and more particularly to assist them in developing methods for promoting that work.

The subject-matter specialists cooperated with the office of exhibits and the office of motion pictures in the



preparation of exhibits and motion-picture films prepared for the extension field. They also cooperated with the radio service in the preparation of questions and answers for the "Fifty Farm Flashes."

About 900 part-time or full-time subject-matter extension specialists were employed by the States, as follows: Agricultural engineering, 46; agronomy, 109; animal husbandry, 83; clothing and millinery, 58; dairying, 94; entomology, including bees, 39; farm management, 44; foods, nutrition, and health, 60; forestry, 30; home economics, general, 27; home management and house furnishings, 25; horticulture and pomology, 89; marketing, 38; miscellaneous, 13; plant pathology, 28; poultry, 83; predatory-animal control, 5; rural organization, 20; veterinary, 11.

Accomplishments in several of these lines of work are described in the paragraphs which follow.

#### AGRONOMY

Seed improvement and standardization, leguminous feed crops for livestock, and pasture improvement were outstanding lines of extension activity with crops. In obtaining soil improvement, the development of local sources of lime, the use of home-mixed and high-analysis fertilizers, and increased use of cover crops for green manuring received special emphasis.

Seed improvement and standardization were reported in 42 States, effort being concentrated on (1) developing varieties best adapted to the various sections of a State, (2) standardizing on a few outstanding varieties to further a general seed-improvement project in the community and to simplify problems of marketing the resulting crop, and (3) developing local supplies of high-quality seed primarily for use in a seed-improvement program in the community and county rather than for marketing outside of the community in which it is grown. Small grains, corn, potatoes, cotton, soy beans, and grasses were the chief crops included in the seed-improvement program.

The production of legume and other feed crops and pasture improvement was reported in 44 States. Alfalfa, soy beans, and clovers were the legumes most largely grown. In connection with growing legumes for feed, green manuring, and other purposes, agronomy specialists in 20 States encouraged the use of lime. As in previous years, they were specially active in making lime more

easily available to farmers at the lowest possible cost. Considerable increase was reported in the quantity of lime used.

Excellent cooperation in a number of States was given by manufacturers and distributors of fertilizers and by growers in obtaining the more general use of high-grade fertilizers.

#### HORTICULTURE

Orchard management, home gardening, beautification of home grounds, market gardening, grape production, and the growing of bush and small fruits were leading horticultural activities. The spraying and pruning of fruit trees showed an increase in all States. Community spray rings increased in number and effectiveness, especially in Indiana and Wisconsin. Eradication of fire blight in apple and pear trees was accomplished in Michigan through the influence of fire-blight method-demonstration schools in different parts of the State, lasting 3 to 14 days. The standardization of grades and packs of apples was emphasized in the Western States and in Virginia. The practice of recommending certain standard varieties of tree fruits for commercial planting grew during the year, and grafting demonstrations were given to teach the grafting over of undesirable varieties into desirable kinds.

The orchard spray service in which the Weather Bureau has been cooperating effectively in a number of States grew in importance and extent. Home-orchard work increased in many States. The beautification of home grounds was extended, particularly in Iowa, Wisconsin, and Georgia. Truck-crop operations increased in importance and effectiveness. Certified-seed production was aided by horticultural specialists in Idaho, Indiana, Iowa, Kansas, Maine, Missouri, Nebraska, and Washington. A solid train of 21 cars of certified seed potatoes was shipped from Minnesota to two Missouri counties where growers had asked extension assistance in potato production.

The largest number of horticultural demonstrations reported was with home gardens—36,558—of which more than 30,000 were carried on by farm women, indicating the strong continued growth of interest of women in providing an adequate family diet.

The office cooperated with the Bureau of Plant Industry in preparing and distributing a mimeographed periodical, "The Extension Horticultur-

ist," to horticultural specialists in the States.

#### FORESTRY

The Clarke-McNary Act made available on July 1, 1925, \$50,000 for assisting farmers in the management of their woodlands, the reforestation of waste land, and the more satisfactory utilization of forest products. The administration of this work was placed by the Secretary of Agriculture with the Extension Service of the department. In a joint memorandum prepared and signed by the director of extension work and the Chief of the Forest Service provision was made for effective cooperation between the State extension divisions and the State forestry departments. In June, 1925, the department advised State extension divisions that so far as funds were available it would cooperate with each State to the extent of \$1,500 a year, provided an equal amount was appropriated by the State, the total sum to employ an extension forester and pay his field and office expenses. By June 30, 1926, 25 States had entered into cooperation on this basis. These States were Alabama, California, Colorado, Connecticut, Georgia, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, and Wisconsin. In addition to these Maine has a forestry extension project maintained wholly with State funds.

State extension foresters held their first conference since the passage of the Clarke-McNary law at Washington, D. C., January 11 to 13, 1926, at which 23 States were represented. Among the chief topics discussed were the principles involved in building and carrying out a forestry-extension program for a State and for community, local, and commodity groups. An outline was prepared for assisting extension foresters to analyze forestry problems and determine the projects which can be developed for meeting them. The opportunities which boys' and girls' 4-H club work present for forestry extension were also discussed, and a comprehensive outline was prepared listing the activities which lend themselves to forestry club work.

The most important and generally accepted forestry-extension activity during the year was forest planting. Such planting usually follows after

the locality has experienced more or less forest depletion and has begun to take stock of the increasing area of cleared land not used for agricultural crops. Naturally the interest in forest planting was greatest in the older-settled States of the East, but the project holds a place of importance in the Central States and even in the South. Over 2,300 forest or woodland plantings, involving 11,458 acres, were made under extension supervision. Where large numbers of forest trees were planted, much of the success of the project was due to cooperation furnished by the State forester, in whose nurseries the trees were grown.

Woodland care and improvement were given attention by all of the Eastern States. Windbreak and shelter-belt planting occupied a comparatively small part in the activities of the year, but in the North Central States, which have entered into cooperation, this promises to be a project of importance. The growing of trees in farm nurseries, the planting of roadside trees, the holding of sand dunes by tree planting, measuring and marketing woodlands and forest products, and the preservation of fence posts and other farm timbers were other projects receiving attention.

#### PLANT PATHOLOGY

Extension work was carried on with the introduction or improvement of disease-control practices affecting more than 30 important crops. Greatest attention was devoted to giving assistance in reducing losses due to diseases of orchard crops, potatoes, corn, and wheat.

Orchard spraying was reported in 35 States, extension specialists in plant pathology and horticulture assisting county extension agents in making recommendations on sanitation, cutting out of diseased parts, proper sprays, methods of applying them, and harvesting and handling practice. The spray-service idea developed further, reaching its most advanced stage in New York, where a man was placed in each of 16 counties during the growing season, financed largely by the growers themselves, to advise them as to the effective time for spraying and spray mixtures to use. Disease control of the home orchard continued to be an important project.

Potato-disease control featured the production and introduction of disease-free seed, seed-potato treatment, and spraying. Recognition among growers of what constitutes disease-free seed



and the desirability of planting such seed was further established. Growers of seed potatoes were advised as to methods of producing disease-free seed, and these methods were more generally extended. All 48 States reported work in this field.

Seed-potato treatment was emphasized in 18 States, and in much of the middle western producing territory recommendation of the hot formaldehyde treatment as a substitute for the slower corrosive-sublimate treatment led many growers to adopt seed treatment. Spray work continued popular where potato spraying was profitable.

Reduction of losses from corn root, stalk, and ear rots was reported in 13 States.

Twenty-five States reported on the introduction of the copper-carbonate treatment for controlling stinking smut in wheat. This practice spread phenomenally during the year. In Washington, for example, where the first demonstrations were given in 1921, 2,800,000 acres, or 90 per cent of the total wheat acreage of the State, were sown with treated seed.

The office assisted in the formulation of control recommendations based on investigational work, helped prepare and distribute literature and illustrative material in cooperation with State workers and gave instruction at county agent training schools and in control campaigns among farmers. It cooperated in issuing monthly "The Extension Pathologist," a mimeographed journal prepared for the information of extension plant pathologists. The office was represented in the extension program of the American Phytopathological Society in Kansas City in December, at which were discussed (1) service to growers in communities where the soil is largely given to the production of a single crop and (2) training county extension agents in plant-disease control.

#### ANIMAL HUSBANDRY

During the several previous years, the unfavorable economic situation in the livestock industry necessitated abnormal attention on the part of extension workers to relief measures for most producers of farm animals. With the return of more normal conditions during 1925, extension workers were able to devote their efforts largely to a constructive program of production from types that meet present market demands. Nearly 50,000 demonstrations were conducted in

breeding, feeding, and general management of beef cattle, swine, sheep, and other livestock, exclusive of dairy cattle and poultry. Of these demonstrations over 30,000 were conducted by members of boys' and girls' 4-H livestock clubs, 20,000 of which were with swine. Feed-lot or stockyard demonstration meetings and "schools" were found especially effective in obtaining the adoption of improved livestock practices. Tours of farms on which breeding, feeding, and management demonstrations were being conducted were also used with success for the same purpose. The ton-litter club was one of the most popular livestock projects, the goal being to produce single litters weighing a ton or more in 180 days. These clubs were reported in 29 States, in 26 of which 767 litters made the required weight. Reports were made on approximately 1,500 litters.

Community breeders' associations made a substantial advance in numbers and production. Wool improvement by ewe culling was demonstrated successfully in practically every range State. After several years of very limited activity in the improvement of horses and mules, owing to the status of the industry, considerable work along this line was reported.

Increased interest in the improvement of farm poultry flocks and in the development of commercial enterprises was reflected by nearly 100,000 demonstrations in culling, feeding, sanitation, insect control, and general management conducted by farmers, farm women, and members of farm boys' and girls' 4-H clubs. Demonstration farm flocks were an important factor in obtaining improvement in poultry production. By this system cooperating flock owners were a constant source of subject-matter information and afforded locations for frequent demonstrations in all the phases of feeding, breeding, and management. These farms were maintained under the direct supervision of the county extension agent and were visited at regular intervals by the specialist. Over 237,000 farms were reported as adopting improved poultry practices.

The office distributed a mimeographed periodical entitled "The Extension Animal Husbandman," as a house organ for keeping extension specialists in animal husbandry informed regarding extension methods and successful results achieved by the States.



## DAIRYING

Cow-testing associations, the introduction of improved breeding stock, the growing of legume feeds, the making of better-quality silage, and the sanitary handling of milk and milk products were leading features of extension work in dairying. Over 38,000 demonstrations were conducted, approximately 17,000 being carried on by members of farm boys' and girls' 4-H clubs. The demonstrations by club boys and girls have proved to be particularly effective in establishing purebred stock in the communities in which they were maintained as well as in promoting the more sanitary handling of milk and milk products. Club members were recognized by the national breed associations and by State and county fair associations as being most important agencies for the improvement of the dairying industry. The bull associations made a steady growth. There was a gradual increase in the better care of milk and cream, both for the market and for manufacture into high-quality butter and cheese. The dairy extension specialists cooperated with the nutrition specialists in encouraging farmers to own enough cows to provide the family with milk and butter. Demonstrations with children to bring them to normal weight by the addition of milk to their diet continued to stimulate the use of milk in the home.

## RURAL ENGINEERING

The control of soil erosion by the construction of terracing and soil-saving dams and the clearing of cultivated fields of stones and stumps were the most extensive engineering activities of the year. Field demonstrations and one to three-day schools continued successfully to illustrate the benefits to be derived from the practices recommended and the methods to be used in adopting them. Motion pictures were used to show methods of using explosives in land clearing and to illustrate methods of terracing. Terraces and soil-saving dams were constructed on nearly 27,000 farms. Stumps and stones were removed from 49,000 farms, principally by the use of pyrotol, the surplus war explosive distributed to landowners by the Bureau of Public Roads in cooperation with the Extension Service. Over 11,700,000 pounds of this explosive were distributed during the year.

Drainage and irrigation improvements were installed on nearly 7,000

farms. Drainage was confined largely to the improvement of cultivated fields with a view of increasing crop yield without increasing expenditures for seed, fertilizer, or labor. Irrigation improvements installed consisted largely of structures intended to obtain more economical use of irrigation water, which is rapidly becoming more valuable as the irrigated area increases.

Plans supplied by extension agents for the construction or remodeling of dwellings, barns, hog houses, poultry houses, and other farm buildings were used on over 26,000 farms. Water, sewage disposal, lighting, and heating systems were installed in accordance with extension plans on nearly 10,000 farms.

During recent years there has been a decided change in the amount and character of machinery used on the farm. The high cost of labor has resulted in the wide use of the gas engine, tractor, combine harvester, and other complicated machinery requiring proper care and maintenance, if it is to be operated economically. Demonstrations and schools were held at which instructions were given relative to the proper care, use, and maintenance of such machinery.

## FARM MANAGEMENT

Farm accounts and farm organization, enterprise, efficiency, and cost accounts, the dissemination of timely economic information, and the development of sound extension programs were the leading lines of farm-management activity. Farm account books were furnished to 49,214 farmers. As these books are usually sold rather than given to the farmers, this distribution is one measure of the interest shown. About 9,300 of these account books were summarized as a basis for the guidance of farmers in the selection and conduct of farm enterprises and as an aid to extension workers in developing local and county programs of work. Five States began publishing the monthly economic situation. Two States introduced farm accounting into the rural schools. Four States conducted farm-management tours for the first time. One State added the boys' and girls' farm-account project to the State program. Farm-management demonstrators in a number of States participated actively in the work designed to aid in extension program building. County agricultural agents, with the help of State farm-management demonstrators, as-

sisted some 15,000 farmers in keeping cost-of-production records and influenced 31,695 farmers to change their cropping, livestock, or complete farming systems.

#### MARKETING

During the year extension workers aided cooperative-marketing associations materially by inducing farmers to standardize their crops and market them in accordance with accepted grades and by furnishing information and data helpful to the associations in conducting their business. To the 2,294 associations previously organized under extension auspices, 973 new associations were added during the year. The sales of these associations amounted to over \$180,000,000, and purchases to \$35,000,000.

Calls for service in point-of-origin and terminal inspection increased generally. Point-of-origin inspection brought to the producer the necessity of producing commodities of such quality as will pass this initial inspection. It also helped protect cooperative-marketing associations against unfair terminal-market practices. Eggs were improved in quality because of the introduction of standards whereby individual shippers and cooperative-shipping organizations could meet the demands of the large consuming markets. Cooperative-shipping associations for the marketing of livestock and fruits, vegetables, and some types of tobacco in many cases increased the returns to the producer very appreciably. Wool pools in the principal wool-growing States were popular. Greater familiarity with commodity grading and the buying and selling practices of the business world, gained through the operations of cooperative-marketing associations, proved very helpful to producers in bringing about more favorable relationships with dealers and with transportation and credit agencies.

#### FOODS

The selection, preparation, production, and preservation of foods for home use and the profitable disposal of the excess supply of home-grown products were major subjects of home demonstration activity. Over 330,000 demonstrations were conducted in this field by farm women and girls, somewhat less than half the number being conducted by the latter. About 100,000 were demonstrations in food production in home gardens and orchards, poultry, and dairying. The work with

home gardens and orchards, in particular was aimed at (1) improving and increasing the supply of green and leafy vegetables and of fresh fruits, (2) to produce vegetables and fruits for preservation for winter use, and (3) in some cases to increase the sale of surplus fresh and canned products. In marketing such products farm women learned the value of high quality in farm and home products. The cooperative-marketing associations organized and managed by them met the needs of small quantity production and developed a cooperative community spirit. Such organized marketing was in the form of egg-marketing circles, carload shipments of poultry, exchanges, home-industry shops, curb and club markets. Extension agents acted in an advisory capacity and gave instruction in production and standardizing products for market. The large variety of products sold at the curb or club markets included live and dressed chickens, eggs, dressed turkeys, rabbits, milk, cream, butter, buttermilk, cottage cheese, sausage, lard, cured meats, fresh and canned vegetables and fruits, jams, jellies, fruit juices, pickles, dried fruits, crystallized fruits, nuts, honey, sauerkraut, breads, cakes, beaten biscuits, cookies, candy, roast fowl, chicken salad, salad dressings, potato chips, bulbs, potted plants, and cut flowers.

Over 121,000 demonstrations were conducted in food selection and preparation, including bread making, vegetable and meat cookery, preparation of dairy-product dishes, general meal preparation, and budgeting the family food supply. In canning and otherwise preserving fruits, vegetables, meats, and fish, and in providing better food-storage facilities, 103,000 demonstrations were carried on, resulting in the canning of over 12,000,000 quarts of food products, the drying of 702,000 pounds of fruits and vegetables, and the curing of nearly 7,500,000 pounds of meats.

#### NUTRITION

The practical benefits of good food habits were proved by over 80,000 demonstrations during the year. Nearly half of these demonstrations were carried on by members of farm boys' and girls' 4-H clubs enrolled in club activities in food preparation, hot lunches, bread making, canning, and growth work. Lines of extension effort with adults were in food selection for the family, health education of



children of school age, feeding expectant and nursing mothers, infants, and children of preschool age, food preparation, food preservation and meal planning as related to nutrition, food-preservation budgets, food-budget gardens, and hot foods to supplement school lunches. Demonstrations of deviations from the optimal in growth and development were emphasized during the year, and important deviations became more readily recognized as the picture of the optimal was held up by the extension worker.

Nutrition information was extended to adults largely through series of three to five meetings of local groups, at which talks and demonstrations in methods by extension workers and local leaders were given. The talks were illustrated where possible with lantern slides, photographs, motion pictures, posters, and exhibits. Living models were used with much success in demonstrating health and growth standards in a positive way. Supplementing the group meetings held, demonstrations in nutrition were carried on by men and women and by groups of children of school age.

With boys and girls there was an appreciable increase in growth work. State health contests were held, and 4-H club members were given physical examination at State and county camps. Food-habits score cards were used effectively in holding the interest of growth-club members, who were encouraged to adopt and exemplify the slogan, "Each club member is his own best exhibit."

The office cooperated in making available printed and mimeographed matter, lantern slides, photographs, and posters helpful to extension workers and local leaders. The office also cooperated in the consideration of nutrition problems at regional conferences of State extension directors held at Pullman, Wash., in November, 1925, and at Ames, Iowa, in April, 1926. At Ames a special supplementary conference attended by extension food and nutrition specialists of the Central States was held, at which recommendations were formulated for long-time State programs, the coordination of effort with adults and juniors, the training of nutrition specialists, cooperation with other workers, and subjects on which further research was needed. The office conferred and cooperated during the year with representatives of the McCormick memorial fund, the American Child Health Association, the National Committee on Boys' and Girls' Club Work, and other

agencies on problems relating to the advancement of nutrition work.

#### CLOTHING

Demonstrations in relation to clothing numbered over 244,000, somewhat more than half being conducted by girls. These demonstrations included plain garment construction, short cuts and time-saving methods in construction, use and alteration of commercial patterns, foundation or type patterns, layettes, clothing for children, selection of materials, selection of ready-made garments, study of color, line, and design, dress forms and their proper use, clothing in relation to posture and health, hat making, renovating, and remodeling, flower making, home dyeing, decorative and tailor finishings, proper corsetry, selection of shoes, clothes closets, clothing accounts and budgets, care of sewing machine and use of the attachments, and sewing and care of furs.

As many women and girls purchase ready-made garments and hats, better buying was taught with reference to durability, suitability, design, and price. In hat making only simple processes were taught, such as the renovating of hats and material and the use of materials on hand. Maine had a project featuring healthful clothing, which included correct footwear and good posture. Other States which specifically presented some phase of the clothing project in its relation to health were: California, Connecticut, Illinois, Maryland, Massachusetts, Missouri, Nebraska, New York, North Carolina, Texas, Vermont, and Wisconsin.

Montana has worked out an attractive and practical demonstration on the clothes closet which includes the essentials of a good closet, how to make improvised closets, commercial and homemade equipment, storage of garments and household textiles, and protection of garments in frequent and infrequent use. Washington has a project on furs, including the method of cutting and sewing, native skins and their use, and renovation and re-making of fur pieces. Maryland presented a clothing-budget plan which includes the inventory, the list needed to be purchased by seasons, and the account of the year's purchases. Other States which showed some interest or conducted demonstrations in clothing accounts and budgets were Alabama, California, Indiana, and Vermont. New York has a project that featured short cuts in sewing. Sew-



ing-machine schools have been held for giving instructions in the proper care and use of the sewing machine.

Healthful clothing, the storage and protection of garments, clothing accounts and budgets, the cutting and sewing of furs, and group instruction in the care and use of sewing machines were some of the newer projects carried on during the year.

#### HOME MANAGEMENT

Some 50,000 demonstrations were conducted in home management, involving (1) the management of time and energy and (2) the management of income or the material resources. The demonstrations that had for their ultimate goal the conservation of time and energy were those in labor-saving home equipment; kitchen improvement and rearrangement; installation of water, sewage, light, and heating systems; house planning and remodeling; housekeeping methods and schedules; and studies in human efficiency. Those relating to business methods were in recording the home supply of products used; budgeting the needs of the home and family and the expenditure of funds; the keeping of accounts of the household business; and organized cooperative methods in marketing home products.

Extension workers reported that about 70 per cent of the working hours of farm women is spent in and about the kitchen, and that inconvenient, poorly equipped, and unattractive kitchens made household tasks very hard and uninteresting. The plans and suggestions given were therefore those that would obtain the maximum of convenience and attractiveness at the minimum expense, finances of the farm family often being limited. Improvements ranged from the addition of small equipment, rearrangement of larger equipment to save steps, and readjustment of the heights of working surfaces to the doing over of the whole kitchen and the installation of water and waste-disposal systems.

Kitchen contests were conducted in 21 States. The kitchens of contestants were scored and rescored by extension specialists, county home demonstration agents, or by a trained committee of disinterested women. Interest and enthusiasm were aroused, and resourcefulness on the part of the whole family was developed. The community or county tour was a popular means used to bring attention to the improved kitchens. At the time of

the visit and inspection each demonstrator reported the changes made, the cost, and the degree of satisfaction. County "achievement days," to which the public was invited, sometimes closed the contest with an appropriate program. Publicity given the high-scoring kitchens often resulted in interested men and women traveling many miles to see and get suggestions. The contests were county wide or limited to a certain number of communities. Washington and Texas each conducted a state-wide contest in cooperation with a State farm publication.

A most important contributing factor to the saving of time and energy in the farm home was the help given by the rural engineering specialists in the installation of water and sewage systems and in the planning of conveniently arranged houses or the remodeling of old houses.

The systematized planning of household work was demonstrated by nearly 15,000 farm women. The results indicated that these women had more time for rest periods, reading, recreation, companionship with family, and community interests than they had previously.

Encouragement was given to farm women in keeping records of the amount and value of food products used which are furnished by the farm. When once the record is kept, the farm family has a better realization and appreciation of what its cows, poultry, orchard, and garden contribute to the living. These records were usually kept in connection with household accounts and were considered in the budget making.

#### HOUSE FURNISHING AND BEAUTIFICATION

The principles of good decoration and furnishing were applied in an appropriate and inexpensive way to living rooms and other rooms in the house in demonstrations conducted by over 63,000 farm women and girls. The refinishing of old furniture, inexpensive and harmonizing decoration, and proper arrangement of furniture improved the interiors of these demonstration homes. Such simple changes as the discarding of gaudy pictures, the proper hanging of well-selected ones, the dyeing of inexpensive drapery material for color effect, the addition of homemade rugs, and the proper placing of vases, lamps, and flowers were made. The demonstrations were given wide publicity and in some counties were brought to the

attention of a large number through home-improvement tours.

The improvement of the interior in many cases acted as an incentive to beautify the outside of the house and the surrounding grounds. The demonstrations carried on as a result usually followed a definite plan, being sometimes in progress for three or four years. The appeal of the beautiful also found evidence in the demonstrations with flowers, which were grown for use in the homes, for making the grounds more attractive, and for sale.

#### HOME HEALTH AND SANITATION

Definite consideration was given to the presentation of such projects as nutrition, clothing, home management, and home improvement in their application to health. Not only the essential health requirements for adults and boys and girls were discussed, but correct posture, corrective exercises, and recreation had a place in the health program. Health and food habits score cards were used extensively and were helpful in teaching positive health standards. Sanitary measures, such as screening against flies, good ventilation, pure drinking water, sewage disposal, and adequate provisions for bathing were emphasized.

Home nursing, first-aid training, and personal hygiene were also demonstrated. State extension divisions co-operated with various health agencies and organizations in their educational programs, 546 extension agents reporting the coordination of their health program with that of State and county health authorities.

#### REGIONAL REPORTS

The administrative work of the office relating to its cooperation with the States is divided into four regions—eastern, central, southern, and western—with a regional agent for each. Outstanding developments in extension activity in these regions are discussed in the following paragraphs.

##### EASTERN STATES

The Eastern States include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia, with Miss F. E. Ward representing the office as regional agent.

Increased attention was given to dairy extension work in this territory,

particularly in the development of a system of cow testing in which the farmer takes his own samples and weighings and sends them to a central point for testing and record. The growing of legumes, particularly alfalfa, in the dairy section to provide feed and reduce feed costs was emphasized. The testing of cattle for tuberculosis and the eradication of tubercular cows made steady progress.

In poultry production, disease control and the use of sanitary and preventive measures in raising chicks and caring for laying hens was given especial attention. The proper selection, feeding, and management of farm and commercial flocks continued to be emphasized.

The orchard and vineyard spray service was developed to a high degree in New York. Potato spraying through the use of community spray rings made a marked advance in Pennsylvania.

Forest plantings on lands unsuited to profitable field-crop production increased, and more attention was given to the care and management of existing farm wood lots. The work was given a large impetus through a considerable addition to the existing personnel. Twelve extension foresters are now at work in the Eastern States, 10 having been appointed during the year under the Clarke-McNary Act.

Extension workers in the Eastern States held their annual conference at Washington, D. C., March 3 to 5. The conference considered problems of organization and supervision in agricultural and home-economics extension.

The various conferences on nutrition which have been held in the Eastern States during the past few years bore fruit in the increased attention given to the improvement of the food habits of the people. Much practical help was given farm women and girls in dealing with the various phases of clothing problems. Although this work dealt principally with construction and remodeling of garments, consideration also was given to standards of dress, dealing with fundamentals of beauty, comfort, and durability rather than fashion.

More than 11,000 communities in the 12 Eastern States carried out programs in extension work cooperatively developed by the extension agents and the people concerned. In these communities 35,000 local leaders were actively engaged in forwarding this program.

The funds used for extension work in this area are increased from



\$3,853,692 in 1925 to \$3,934,997 in 1926 and the staff employed from 826 to 862. Four new county agricultural agents, 11 home demonstration agents, and 5 county club agents were added to the staff. The number of extension specialists increased from 230 to 249. Of this number, 205 were employed in the field of agriculture and 44 in the field of home economics.

In Rhode Island, G. E. Adams was appointed extension director to succeed A. E. Stene, resigned; and in Massachusetts, W. A. Munson was appointed extension director to succeed John D. Willard.

An advance step was taken in New Hampshire in legislation affecting extension work. The State legislature passed an act making it possible for counties to employ three county extension agents, namely, one county agricultural agent, one home demonstration agent, and one club agent, in cooperation with county authorities, the University of New Hampshire, and the United States Department of Agriculture. This makes available to each county a maximum of \$1,200 of State funds for the employment of each of these agents, in addition to the \$600 the college contributes from Smith-Lever sources, provided the county likewise appropriates \$1,800 for each of these agents. This makes a total of \$3,600 for the salary and expenses of each agent, all from public sources, or a total in the county of \$10,800 for the three agents.

Definite attention was given at a number of extension conferences to teaching methods. Men from various college and university departments were brought to these conferences to help develop a philosophy of teaching, as applied to extension work. Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, and New York have led in this work.

#### CENTRAL STATES

The Central States include Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin, with G. E. Farrell representing the office as regional agent.

Dairying, legume production, the development of cheaper sources of lime, land clearing, swine sanitation, and livestock marketing were leading agricultural activities in this territory.

The availability of cheap explosives left from the war and their distribution through extension agencies gave

marked impetus to land clearing and ditching in Michigan, Wisconsin, and Minnesota. Michigan has been featuring alfalfa and dairy campaigns. As a result, the alfalfa acreage, which was 193,000 acres in 1922, with 11 cow-testing associations, increased to 494,000 acres in 1925, and the 11 cow-testing associations existing in 1922 increased to 105 associations in 1925. In Illinois the campaign to secure the increased use of limestone has resulted in increasing the acreage from 247,000 acres in 1921 to 801,000 in 1925, during which period practically 2,400,000 tons of agricultural lime were used in the State. Eleven States conducted agricultural campaigns of one kind or another. One Indiana county reported a legume campaign which resulted in 250 farmers sowing 3,000 acres of alfalfa.

One of the most outstanding pieces of work in Nebraska was in swine sanitation, in which approximately 200 demonstrations were completed. In this work the increased income on 81 farms on which pigs were farrowed in small houses and raised exclusively on clean ground averaged \$481.32 per farm. On 35 farms on which pigs were farrowed in large houses properly scalded, then moved to clean ground and raised there, the average increased income was \$296.20, whereas on 16 farms on which only a part of the sanitation plan was followed out, there was no increased income.

In Wisconsin the extension forces have given special consideration to the marketing of the surplus dairy cattle. The number of dairy cows sold from the State has increased from around 25,000 in 1921 to approximately 60,000 in 1925, in which work the extension service has played a substantial part.

The entire energy of the people was not centered upon production and marketing, but increased attention was given to the development of a wholesome and enriched life in the open country. Camps for boys and girls were organized, as well as camps for women. Iowa has developed its corn-husking contest; South Dakota has a state-wide debate; Indiana has a farm woman's camp; a conference for farm women was held in Michigan. In Missouri more than 50 communities developed programs providing for agriculture, home economics, education, recreation, and civic improvement.

The number of farm boys' and girls' 4-H club encampments increased from 349 in 1924 to 374 in 1925. The num-



ber of club members enrolled per county extension worker increased from 162 to 183, and the number completing increased from 106 per county worker to 126. A 4-H club members' conference was held at the interstate fair at Sioux City, Iowa, at which 120 older club members, representing 12 States, came and received instruction in leadership. Several forestry clubs were started in Wisconsin with boys 14 to 21 years of age. Health and growth work were also a prominent phase of the work with juniors.

A regional conference of extension workers in the Central States was held at Ames, Iowa, April 26 to 28. The conference was conducted on a sectional basis, the subjects of the sections being nutrition, home demonstration work, and county agricultural agent work.

More than 21,000 farm women gave an average of one day a month for each of five to six months to receive training as local leaders in food, clothing, home management, and other projects relating to the farm home, and pass it on to their neighbors. These project leaders assisted in giving such instruction to 256,000 women.

In most of the States the extension program of the county agents was developed cooperatively with the local people. Eight States reported from 60 to 100 per cent of their agents working on a community program basis, and five of these States reported all of their agents on such a basis.

During the year \$6,850,000 was spent for extension work in this territory, a decrease from the previous fiscal year of \$67,000. Notwithstanding this decrease in funds, there was an increase from 1,501 to 1,527 in the number of extension workers employed. Seven new county agricultural agents, 7 new county home demonstration agents, 1 new county club agent, and 11 new subject-matter specialists were added during the year.

Increased attention was given to training the extension personnel, either at the State agricultural college, through study at other institutions, or otherwise. Practically 98,000 local leaders gave assistance to the paid staff in promotion of extension work. Considerable attention was given by the college to the training of these leaders, and training schools were conducted in 20 counties in Ohio and 40 in Iowa. In Iowa, Minnesota, Missouri, and Ohio extension sociologists were employed to emphasize a whole rural-life community program.

#### SOUTHERN STATES

The Southern States include Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia, with O. B. Martin representing the office as regional agent.

Soil building through the increased use of winter and summer legumes received much attention in this group of States. In Alabama, for example, the use of hairy vetch has increased from a few hundred pounds of seed a few years ago to 700,000 pounds in 1925. There has been a marked increase, also, in the use of soy beans. Both men and women agents have united in promoting poultry and dairy work. The holding of club markets for the sale of local products was encouraged by the home demonstration agents and had much influence in getting better methods of grading and the standardization of products more generally adopted.

Much attention continued to be given to marketing extension work. This was of a somewhat different form from that given two or three years ago, when it was largely concerned in the development of marketing organizations. The marketing work of the year was more along the line of counsel to these organizations and assistance to farmers in standardizing their crops and grading them in accordance with accepted grades. The associations previously formed showed ability in an increasing degree to handle their own marketing work. County agricultural agents showed a fuller realization that their task is one of teaching farmers how to handle their own marketing problems rather than themselves undertaking such work for the farmers.

At the annual conference held at Atlanta, Ga., February 1 to 3, southern extension workers discussed financial support, long-time regional programs, and district, county, and community program making, leadership, extension work as a unit, the whole farm a demonstration, negro work, and relation of extension to cooperative organizations and to vocational education work.

Some 273,000 farm boys and girls were enrolled in 4-H clubs in this territory, over 130,000 meeting all requirements of the work for the year. The main lines of activity with boys were with cotton, corn, pigs, and poultry, and with girls, clothing, food

preparation, food preservation, home gardens, and nutrition.

In boys' club work, some particularly outstanding demonstrations were carried on with cotton. In Simpson County, Miss., 565 boys conducted demonstrations in cotton growing, of whom 338 completed their demonstrations and handed in record books. The 338 reporting showed an average of more than 1,500 pounds of seed cotton per acre, or 516 pounds of lint. In these cotton demonstrations each boy was required to leave two rows unfertilized through the center of his acre. The fertilized areas showed a production two to four times as great as the unfertilized.

Junior club camps to the number of 1,262 were held in the Southern States. The movement on the part of the clubs toward self-government as developed in Arkansas spread further into a number of States.

One of the new projects to which much attention was given in these States was the forestry work under the Clarke-McNary Act. All but two States in the group employed forestry extension specialists and began forestry extension work.

The funds for extension work in the 12 Southern States increased from \$6,058,815 in 1925 to \$6,139,600 in 1926, and the number of extension workers from 2,026 to 2,048. Twenty-nine new county agricultural agents and 12 subject-matter specialists were added, while the number of supervising agents was reduced by nine. Ten less county home demonstration agents were employed. Forty-one per cent of all extension workers were employed in this territory.

#### WESTERN STATES

The Western States include Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming, with W. A. Lloyd representing the office as regional agent.

At the annual regional conference of State directors of extension of the Western States held in November, 1925, at Pullman, Wash., committees reported on range livestock, dairying, farm crops, and human nutrition as leading subjects of extension activity in this territory. Extension directors of 9 of the 11 Western States also participated in a new type of extension conference. For 11 days in May they traveled by automobiles through 16 counties of California, stopping at farms and homes to observe extension

activities under way and to discuss extension procedure with the demonstrations before them.

Under range livestock, cattle grading, culling of females, wool grading, and the introduction of improved grazing were the projects most successful. Dairy production was somewhat curtailed owing to the shortage of feed in the West in 1924 and the improved prices of wheat and other crops. The organization of cow-testing associations was the major dairying project, making substantial increases in number and membership. Seed improvement, disease control, and weed eradication were emphasized in relation to farm crops. Control of stinking smut in wheat through the copper-carbonate treatment was widely demonstrated and practiced in the wheat-growing areas. An improved food supply for the farm family, particularly through the vegetable garden and home orchard, canning and storage, improved food selection and preparation, child-health demonstrations, hot school lunches, and group work with children of preschool age and their mothers were features of the work in human nutrition.

The development of State extension and agricultural programs made marked progress. Arizona, California, Idaho, Montana, Nevada, and New Mexico took up the work, and institutional committees were organized. In Oregon, the first State in the West to undertake the development of a State extension and agricultural program, 17 counties held county economic conferences in which the people took part and a definite county program was adopted. Each of the counties thus adopting programs published them in the form of printed bulletins. In Washington two enterprise State conferences were held in farm crops and dairying. Colorado held several district-commodity conferences. California made a study of its peach industry and published the results in bulletin form.

A new type of project has developed in the West in the form of an interstate, or regional, survey involving the experiment stations of several States, cooperating with two or more bureaus of the department. The extension services in these States are parties to the project in that they utilize at once the results obtained in the studies.

The amount of funds available for extension work in the 11 Western States increased from \$2,420,745 in 1925 to \$2,493,460 in 1926, and the number of extension workers from 515



to 528. Nine new assistant county agricultural agents, 1 county club agent, and 13 specialists were added. The number of supervising agents was reduced by 4 and the number of county home demonstration agents by 6.

Most of the Western States have adopted as an administrative principle that the entire salary of the county extension agents be paid from State and Federal funds. This is already the case in Arizona, California, and Utah.

Increased attention was given by county agricultural agents to home projects, practically 92 per cent of them reporting such work. In club work the enrollment, totaling 34,102, was an increase of 18 per cent over the previous year, and the number of completions, 23,170, was 22.5 per cent more. In both club work and home demonstration work, trained project leaders aided greatly in the volume and quality of the work in this territory.

## DEMONSTRATIONS ON RECLAMATION PROJECTS

### ORGANIZATION

The office of demonstrations on reclamation projects is under the supervision of A. C. Cooley, with headquarters in Salt Lake City. The work was extended to four new projects, the Umatilla and Klamath in Oregon, the Strawberry in Utah, and the Huntley in Montana. Service has been continued on the seven projects previously included, the Belle Fourche in South Dakota, the Flathead in Montana, the Minidoka in Idaho, the Newlands in Nevada, the North Platte in Nebraska-Wyoming, the Shoshone in Wyoming, and the Uncompahgre in Colorado. This expansion was made possible by cooperation with the several States in which work was being done, whereby they took over the expenses, and in some cases a part of the salaries, of the demonstrators. Prior to the fiscal year just closed the office had paid the entire salaries and expenses of the field men. Cooperative arrangements with the States for conducting the work on the respective projects were effective as follows: Uncompahgre, Newlands, Shoshone, Umatilla, January 1, 1921; Klamath, February 16; Strawberry, March 1; Flathead, April 1; Huntley, May 8; Belle Fourche and Minidoka, July 1. With the exception of the North Platte project in Nebraska, where cooperative relations

have not yet been worked out, the work in all the States is now on a cooperative basis.

Rearrangement of the work on a cooperative basis has resulted in some changes in the personnel of the field force. The demonstrators on the Shoshone and Belle Fourche projects resigned, but these vacancies have been filled and five new appointments made to conduct the work started on additional projects. These new appointments were made possible by the cooperation of the States and did not result in any increase in Federal expenditures. Demonstrators on reclamation projects are now, with a single exception, members of the State cooperative extension staffs and are recognized as a part of the extension service.

### FIELD WORK

The work of the field representatives has continued along practically the same lines as during the previous year.<sup>4</sup> Their activities have been devoted largely to dairying, poultry, and sheep. The swine industry, however, due to higher prices for pork, is again demanding considerable attention.

### DAIRYING

Better sires, better feeding and housing, and the elimination of poor-producing cows have been emphasized. One hundred and four farmers were given assistance in selecting and obtaining purebred sires, and 82 in procuring purebred females. Forty-two herds, numbering 921 animals, were culled and 86 inferior animals eliminated. Eight bull associations, with a membership of 49 farmers, and 3 cow-testing associations, with a membership of 73, and including 1,263 cows, were organized. In all, 301 dairy demonstrations were conducted, involving 1,895 animals. As a result of these various activities, better practices on 627 farms were reported.

A brief statement of the results of the dairy work on the Newlands (Nev.) project since it was begun in 1914 will illustrate its value. The number of dairy cows, exclusive of heifers, reported for the Newlands project in 1915 was 2,579, with less than 10 registered dairy sires. The Bureau of Reclamation census for 1924 shows 4,932 producing cows and

<sup>4</sup> Results reported are for the calendar year 1925 and represent the work of seven demonstrators, all additions to the force having occurred since Jan. 1, 1926.



198 registered sires. The foundation herds in 1915 had an estimated average annual butterfat production of about 180 pounds per cow, whereas the average production of the present herds on the project, as estimated from records of the cow-testing association, is 263.4 pounds, an increase of 83.4 pounds per cow. With butterfat at 40 cents per pound, this means that the project farmer, by adopting improved methods, has increased his annual income by \$33.36 per cow. This would mean an increase in revenue of approximately \$165,000 a year for the project, or about \$216 per project farm. Reports of sales provide further evidence of the development and improvement in the dairy industry. In 1915 butterfat sales for the project were reported as 276,656 pounds, and in 1925 approximately 1,275,000 pounds, an increase of 995,344 pounds of fat, which at 40 cents per pound would be nearly \$400,000. Dividing this sum by the number of project farms, 762, shows an average sales income from this butterfat of more than \$500 per farm.

In feeding, the demonstrators have stressed balanced rations, made up of home-grown feeds, and the need of more summer pasture. As a result of the pasture campaign, sweet-clover and mixed-grass pastures are becoming common on several of the projects. Approximately 300 acres, varying from 1 to 15 acres per farm, were seeded to pasture last spring as field demonstrations. Progress in the better-housing program depends on the degree of prosperity enjoyed by the farmers. Reports from five of the projects show 17 barns and 23 silos built or remodeled during the year.

#### POULTRY

Feeding, culling, housing, and marketing of poultry were again emphasized. Improved practices were adopted on 190 farms, and more than 300 demonstrations involving 35,875 birds were conducted. One hundred farms culled their flocks for the first time, with 10,189 hens handled and 2,606 discarded. Many farmers were helped in improving their feeding practices. Fifty-eight farms were furnished plans for remodeling old or building new poultry houses, and nearly 100 farmers were assisted in obtaining purebred stock.

Several poultry associations have been organized and are doing good work. An association on the North Platte project marketed 17,200 dressed

turkeys for its members, for which they received \$64,306. The activities of this organization raised the local market price 5 cents a pound, which is estimated to have been worth \$25,800 to the growers of that section. Other associations are making carload shipments of eggs and live poultry.

#### SHEEP

The interest in farm sheep reported last year seems to have been lessened by lower wool prices and the poor returns received by lamb feeders who failed to market their lambs early. This condition, however, has resulted in a sounder and more conservative growth. The principal work with sheep has been in locating and selecting desirable stock for those wanting it. More than 300 demonstrations were conducted with sheep, and over 1,200 farmers have been given assistance of some kind in the furtherance of the industry. As sheep raising is a new enterprise for many, the demands on the field men for help have naturally been very great, particularly with reference to feeding problems. Some losses have occurred, but considering the newness of the enterprise and the rapidity with which it has developed, the results have been very encouraging. It is hoped that the sheep industry on reclamation projects can be stabilized on a profitable basis.

#### SWINE

A study of the rise and fall of the hog industry emphasizes again the need of stability in our farm practices and a well-thought-out, long-time program. High-priced pork has again stimulated a keen interest in hogs, and the demand for brood sows and feeder pigs has been greater than the supply. Locating these animals for farmers has been the principal activity in the swine project. Better methods were put into practice on 114 farms, and 115 adult demonstrations were conducted.

#### BOYS' AND GIRLS' CLUBS

The work with boys and girls has always been an important part of the demonstrations on reclamation projects. Six of the demonstrators report having done club work. The number enrolled in the livestock clubs was 312, divided as follows: 139 in dairying; 67 in swine production; 50 in sheep raising, and 56 in poultry. The work done by these young people

has been valuable as a demonstration of what can be accomplished when good farm practices are carefully followed. Boys and girls in clubs cared for 179 calves, 238 pigs, 66 lambs, and 737 chickens. The value of the training and experience received by them can not be estimated. They have also contributed to the interest in better agriculture in their home communities. Club work has always been effective in creating and maintaining interest in the whole extension program.

#### MISCELLANEOUS

Demonstrators on reclamation projects made 4,236 farm visits and received 5,906 office and 4,387 telephone calls for information. There were 5,057 individual letters written, 10 extension schools conducted, with an attendance of 1,567, and 308 extension meetings held, with an attendance of 15,640. Much time was also given to assisting with community and county fairs, junior club encampments, and other matters of interest to the people on the respective projects.

#### MOTION PICTURES

The office of motion pictures continued under the supervision of Fred W. Perkins, without material change in personnel.

Accomplishments during the year are briefly summarized as follows:

Completion of 24 new motion-picture subjects of one reel or more, the total number of reels being 44.

Circulation of the department's films to a country-wide audience partially reported as 2,453,171, and believed to total at least 10,000,000.

Authorization of sale, to cooperating institutions and other creditable purchasers, of 234 prints, totaling 335 reels, at a cost to purchasers of approximately \$11,000.

Revision of 20 old films, and beginning of scenario or production work, or both, on 30 new subjects.

#### INCREASE IN CIRCULATION

Our reports indicate clearly that the department films are being shown before an audience that grows annually. The actually reported audience is somewhat smaller than for the preceding 12 months, as no figures were furnished by some of the largest distributors and exhibitors who have been using films regularly. A more accurate indication of the use of de-

partment films is the record of film shipments from the laboratory. These figures show steady growth from 2,066 in 1922, 2,175 in 1923, 3,199 in 1924, and 4,260 in 1925 to 4,276 in 1926. The value and popularity of the department films is further attested by sales to purchasers, which were larger by almost 20 per cent than in the previous year. These purchasers represented all sections of the United States and many foreign countries.

Nearly 2,000,000 feet of film are now in circulation from the laboratory in Washington, with an approximately equal quantity being circulated by cooperating institutions. At the end of the year distribution from Washington included 220 subjects, totaling 1,483 copies and 1,948 reels. During the year 218 copies, of 275 reels, were added to our Washington stock, more than making up for a number of old subjects which were withdrawn from circulation.

#### NEW FILMS COMPLETED

The new motion-picture films completed during the year number 24, and are as follows:

Poor Mrs. Jones (4 reels, Extension Service).

From Ranch to Ranch in California (4 reels, Extension Service).

John Doe's Cotton—and Yours (2 reels, Extension Service).

The Short Course (1 reel, Extension Service).

Home (1 reel, Extension Service).

Trees of Righteousness (3 reels, Forest Service).

What the Forest Means to You (2 reels, Forest Service).

Harvesting Uncle Sam's Timber (2 reels, Forest Service).

Marking Timber (2 reels, Forest Service).

Roads for All America (6 reels, Bureau of Public Roads).

Tests for Better Roads (1 reel, Bureau of Public Roads).

Impact of Traffic on Roads (1 reel, Bureau of Public Roads).

The Bates Road Tests (1 reel, Bureau of Public Roads).

Dynamite—Concentrated Power (1 reel, Bureau of Public Roads).

Turn on the Water (1 reel, Bureau of Public Roads).

Clouds (1 reel, Weather Bureau).

John Smith v. Jack Frost (2 reels, Weather Bureau).

Profits from Cull Oranges and Lemons (1 reel, Bureau of Chemistry).

Alfalfa Weevil Control (1 reel, Bureau of Entomology).

Holding the Japanese Beetle (1 reel, Bureau of Entomology).

The Horse and Man (1 reel, Bureau of Animal Industry).

The Cow Business (1 reel, Bureau of Animal Industry).

Magic In It (2 reels, Bureau of Agricultural Economics).

Cooperative Marketing—Pacific Coast Eggs (2 reels, Bureau of Agricultural Economics).



The above films, in number of subjects and in total number of reels, represent approximately the average yearly production of our present personnel, although the number of subjects is slightly less and the number of reels is slightly more than in the preceding year.

Greater emphasis is being placed on quality, however, than on quantity production, and it is believed that improvement in this respect has continued. Reports indicate that the department motion pictures have attained a wide and pleasing reputation as being informative, interesting, well planned, well directed, and well photographed.

#### NEW FILMS IN PREPARATION

Films now in preparation, on which considerable preparatory or actual production work has been done, and most of which should be completed within the next few months, include the following:

- The Barnyard Underworld (Bureau of Animal Industry).
- The Travels of a Banded Duck (Biological Survey).
- Back of the Weather Forecast (Weather Bureau).
- Seed Inspection Work (Bureau of Plant Industry).
- House Moths (Bureau of Entomology).
- Turf (Bureau of Plant Industry).
- Saving Soil by Terracing (Bureau of Public Roads).
- The Housewife's Day (Bureau of Home Economics).
- Food Makes a Difference (Bureau of Home Economics).
- Child Training (Bureau of Home Economics).
- Apples or Cedars? (Bureau of Plant Industry).
- Animal Heredity (Bureau of Animal Industry).
- Wild Flower Preservation (Bureau of Plant Industry).
- Growth of Plants (Bureau of Plant Industry).
- South American Commerce (Bureau of Public Roads, cooperating with Department of Commerce).
- Pan American Journalists' Tour (Bureau of Public Roads, cooperating with Highway Education Board).
- Corn Borer Control (Bureau of Entomology).
- Corn Borer Quarantines (Bureau of Entomology).
- Boll Weevil Control (Bureau of Entomology).
- Cooperative Marketing Growth (Bureau of Agricultural Economics).
- Boys' and Girls' Club Camps (Extension Service).
- Farm Women's Recreation Camps (Extension Service).
- Farmers' Recreation Camps (Extension Service).
- Forest Fire Prevention (Forest Service).
- Forestry in Southern Appalachians (Forest Service).
- Road Building in National Parks (Bureau of Public Roads).

- Range Extension Tour (Extension Service).
- Range Management (Forest Service).
- Brick Road Tests (Bureau of Public Roads).
- Farm Home Improvement (Extension Service).

#### SALE OF PRINTS

Sales of copies of department motion pictures were authorized to the extent of 234 prints, totaling 335 reels. The purchasers included five foreign countries, one of which bought 42 and another 33 films. In addition to direct sales to foreign governmental agencies, sales were made to associations or firms in several other foreign countries. Purchasers also included seven State universities and colleges of agriculture, two State departments of agriculture, the public school boards of two of our larger cities, a State health commission, and three national associations of manufacturers. The dairy councils in six cities bought copies of the films entitled "Milk for You and Me," and five State cooperative marketing associations purchased copies of cooperative marketing films.

#### EXHIBITS

##### ADMINISTRATION

The office of exhibits continued under the supervision of Joseph W. Hiscox. The centralization of the exhibit services of the department has resulted in uniformity of practice and design in its educational exhibits. The organization has proved well adapted to the planning and preparation of the department's exhibits, and requests for participation in agricultural fairs, shows, expositions, and special occasions have steadily increased.

While the present organization is suitable for handling the department's exhibits problems, it has been unable to meet the exhibit needs of the department owing to lack of sufficient funds.

The financial cooperation between the department and the fairs and expositions resulted in total special deposits amounting to \$6,410 received from 42 fairs and expositions, to cover the cost of transporting and installing exhibits. These special deposits were received from fairs and expositions in 24 States and the District of Columbia. The cost to the department for participation in fairs and expositions was approximately \$109,540. Adding to this the contributed funds makes a total for the entire project of approximately \$115,950.



The office has for several years occupied the main floor of a warehouse building in Alexandria, Va., containing approximately 15,000 square feet. Although a large quantity of obsolete and unserviceable material was disposed of at public auction, it was necessary to obtain additional storage space to care for the regular serviceable exhibits and for those prepared for the Sesquicentennial International Exposition. On March 1, 1926, the basement of the Alexandria warehouse was rented, containing approximately 14,400 square feet. Though this warehouse is not ideal for the department's purpose, it is more suitable than any other space which could be obtained at a like cost. Seven carloads of exhibits were received from the western exhibits circuits for revision and renovation, taxing the storage facilities of the warehouse to its fullest capacity. With the additional space acquired it is now possible to handle current exhibit work more expeditiously, and at the same time take care of new exhibits which may be prepared under special appropriations.

At the end of the year the exhibits personnel numbered 25 in Washington and 9 at the warehouse shops in Alexandria, a net decrease of 1. An emergency force of 9 employees consisting of clerks, exhibits preparators, messengers, and unskilled laborers, has been employed for varying temporary periods for service in connection with the preparation, shipment, and installation of the department's exhibit at the Sesquicentennial International Exposition.

An innovation was put into effect by which certain exhibits preparatory personnel are placed on furlough without pay when their services are not required. At certain periods of the year the work is extremely heavy, and between those periods the volume of work drops to a more normal level. These periods of heavy production are caused by the preparation of special exhibits such as those shown at the National Dairy Exposition and the International Livestock Exposition, and by the renovation of the State fair exhibit material. Between the periods of heavy production or renovation the regular force is generally able to handle the work, but during the periods of increased activities extra personnel is required. It is now possible to have personnel available who are especially suited to our needs, and to retain such services without the necessity of carrying the salaries during times when they are not needed.

The installation and dismantling expenses at major exhibit-showing points have been decreased nearly 40 per cent during the last three years through the development of more efficient methods. The improved system put into effect for installing and dismantling these large exhibits has resulted in reducing the travel and subsistence expenses of Washington representatives and the requirements for emergency skilled labor. The cost of unskilled labor at installation points for handling material and for providing adequate watch service has practically been eliminated, arrangements having been made with exposition managements to absorb such expense.

The salvaging of material from discarded exhibits for use in constructing new material has resulted in making available much needed storage space. New ways have also been developed for utilizing a large number of obsolete exhibit panels by combining them with hinges and fasteners to represent many different structures, such as room interiors, barns, and sheds. This resulted in a saving of approximately \$450 in new material.

#### PREPARATION OF EXHIBITS

During the year 59 exhibits were completed, 12 were revised extensively, 114 were renovated, and 26 are now under construction. These calculations are based on the standard booth unit. A standard booth occupies about 80 square feet of floor space, approximately 24 feet of linear wall space, is 7 feet high, and contains some interest feature. These figures represent the largest program of work so far completed in one year.

Special effort has been made to plan and construct exhibits so that they will attract and hold attention. Each exhibit completed has contained some feature which tends to attract attention or add interest. These features included bromide enlargements, transparencies, objects, live animals, cut-outs representing people, animals, and objects, mechanical movement, moving or changing lights, dissolving scenes, habitat groups, sound produced mechanically, motion pictures, automatic lantern-slide projectors, and moving legends. The number of exhibit units constructed has remained about the same during the last three or four years, but individual exhibits have become more intricate in design and construction and more varied in type and appearance.

Particular attention has been given to reductions in cost of equipment

and machinery and in labor requirements. The planning section has constantly sought new, simple devices for obtaining motion, light, or other effects at minimum cost. For instance, considerable use has been made of thermostat switches, which throw current alternately on two different circuits. Where two movements will suffice this automatic switch, which costs about \$7, will take the place of an electric motor, a flasher, reducing gears, and other apparatus costing \$75 to \$100. Trials are now being made of a revolving table operated by a large spring. This equipment, which costs about \$30, has slow, even motion and will run all day with one winding, thus obviating the use of electric current.

In the building of habitat group and similar exhibits such as those often seen in museums the extra problem is presented of so constructing them that they can be taken apart and packed in relatively small crates and put up again easily and quickly at some distant point. This has been

met by the development and use of a tough, light material not previously utilized for the purpose.

The planning and building section has rendered considerable aid to the various bureaus and offices in the preparation of the department exhibit at the Sesquicentennial International Exposition at Philadelphia. Advice was given on planning, methods of construction, proper material to be used, and other structural detail. In many cases detailed mechanical drawings were prepared. Later help was given in the preparation of exhibits, such as art work, lettering, and modeling. Artists and other workers temporarily employed were also supervised by the regular exhibits personnel.

### EXHIBITIONS

Forty-six major exhibitions were made at State, interstate, and international fairs and expositions, together with 12 minor exhibitions at other points. Following is a list of the occasions, places, and dates at which exhibits were presented:

Occasion	Place	Dates
Southern Fair.....	Atlanta, Ga.....	Oct. 8-17, 1925.
American Health Congress.....	Atlantic City, N. J.....	May 17-22, 1925.
Federation of Women's Clubs.....	do.....	May 24-June 5, 1926.
Baltimore Poultry Show.....	Baltimore, Md.....	Nov. 30-Dec. 5, 1925.
Midland Empire Fair.....	Billings, Mont.....	Sept. 15-18, 1925.
National Wool Growers' Association.....	Boise, Idaho.....	Jan. 18-20, 1926.
Brockton Fair.....	Brockton, Mass.....	Sept. 29-Oct. 3, 1925.
Seven County Fair.....	Brookhaven, Miss.....	Oct. 6-10, 1925.
Southwest Missouri Fair.....	Carthage, Mo.....	Aug. 25-28, 1925.
Kanawha Exposition and Four-H Fair.....	Charleston, W. Va.....	Oct. 5-10, 1925.
International Livestock Exposition.....	Chicago, Ill.....	Nov. 28-Dec. 5, 1925.
Chicago Road Show.....	do.....	Jan. 11-15, 1926.
National Western Stock Show.....	Denver, Colo.....	Jan. 16-26, 1926.
American Society for Municipal Improvements.....	Des Moines, Iowa.....	Oct. 26-29, 1925.
Michigan State Fair.....	Detroit, Mich.....	Sept. 4-13, 1925.
Wyoming State Fair.....	Douglas, Wyo.....	Sept. 15-18, 1925.
Erie Exposition.....	Erie, Pa.....	Sept. 7-12, 1925.
Frederick County Fair.....	Frederick, Md.....	Oct. 20-23, 1925.
Minnesota State Fair.....	Hamline, Minn.....	Sept. 5-12, 1925.
Farm Products Show.....	Harrisburg, Pa.....	Jan. 18-23, 1926.
Montana State Fair.....	Helena, Mont.....	Sept. 7-11, 1925.
National Dairy Exposition.....	Indianapolis, Ind.....	Oct. 10-17, 1925.
American Royal Livestock Show.....	Kansas City, Mo.....	Nov. 14-21, 1925.
Nebraska State Fair.....	Lincoln, Nebr.....	Sept. 6-11, 1925.
Georgia State Exposition.....	Macon, Ga.....	Oct. 19-24, 1925.
Memphis Tri-State Fair.....	Memphis, Tenn.....	Sept. 26-Oct. 3, 1925.
Wisconsin State Fair.....	Milwaukee, Wis.....	Aug. 30-Sept. 5, 1925.
Tennessee State Fair.....	Nashville, Tenn.....	Sept. 21-26, 1925.
New York Automobile Show.....	New York, N. Y.....	Jan. 11-16, 1925.
Chemical Industries Exposition.....	do.....	Sept. 28-Oct. 3, 1925.
Madison Square Garden Poultry Show.....	do.....	Jan. 6-10, 1926.
International Flower Show.....	do.....	Mar. 15-20, 1925.
Norfolk Fair.....	Norfolk, Va.....	Sept. 7-12, 1925.
Sesquicentennial International Exposition.....	Philadelphia, Pa.....	June 1-Dec. 1, 1926.
Arizona State Fair.....	Phoenix, Ariz.....	Nov. 9-14, 1925.
Colorado State Fair.....	Pueblo, Colo.....	Sept. 21-26, 1925.
Western Washington Fair.....	Puyallup, Wash.....	Sept. 21-27, 1925.
Virginia State Fair.....	Richmond, Va.....	Oct. 5-10, 1925.
Rochester Fair.....	Rochester, N. Y.....	Sept. 7-12, 1925.
California State Fair.....	Sacramento, Calif.....	Sept. 5-13, 1925.
National Orange Show.....	San Bernardino, Calif.....	Feb. 18-28, 1926.
All Western Road Show.....	San Francisco, Calif.....	Nov. 9-14, 1925.
Interstate Fair.....	Sioux City, Iowa.....	Sept. 20-25, 1925.
Eastern States Exposition.....	Springfield, Mass.....	Sept. 20-26, 1925.



Occasion	Place	Dates
Spokane Interstate Fair.....	Spokane, Wash.....	Sept. 7-12, 1925.
Illinois State Fair.....	Springfield, Ill.....	Sept. 19-26, 1925.
Maryland State Fair.....	Timonium, Md.....	Sept. 7-12, 1925.
Kansas Free Fair.....	Topeka, Kans.....	Sept. 14-19, 1925.
Trenton Interstate Fair.....	Trenton, N. J.....	Sept. 28-Oct. 3, 1925.
Texas Cotton Palace.....	Waco, Tex.....	Oct. 25-Nov. 8, 1925.
Association of Chemists.....	Washington, D. C.....	Oct. 23-25, 1925.
Eastern Restaurant Convention.....	do.....	Apr. 27-28, 1926.
National Educational Association.....	do.....	Feb. 21-25, 1926.
Washington Radio Show.....	do.....	Sept. 28-Oct. 4, 1925.
Dairy Cattle Congress.....	Waterloo, Iowa.....	Sept. 26-Oct. 4, 1925.
Southwest Road Show and School.....	Wichita, Kans.....	Mar. 2-5, 1926.
Texas-Oklahoma Fair.....	Wichita Falls, Kans.....	Oct. 3-8, 1925.
Washington State Fair.....	Yakima, Wash.....	Sept. 14-19, 1925.

These exhibitions were attended by nearly 4,000,000 people and were distributed among 27 of the 48 States. The exhibitions occupied a total floor space of 82,100 square feet, exclusive of aisles.

Exhibitions are made on application from fairs or other organizations desiring them. The cooperating organization is asked to furnish space without cost to the department; to deposit an amount to cover the cost of railroad transportation of the exhibit; and to bear all costs incident to installation of the exhibit, such as labor, drayage, and current. Most of the major exhibitions are arranged in circuits for groups of exhibits, whereby they are sent to as many fairs or expositions as possible before return to Washington. This reduces the cost of transportation and handling to a minimum.

For convenience in conducting exhibitions under this arrangement, the 11 Western States are divided into six groups corresponding with the Forest Service districts. The fairs in these districts are served through a department exhibit committee in each district operating under the direction of this office. Eleven exhibitions were held in these districts. Six circuits were organized to serve the section east of the Rocky Mountains. These were operated by personnel assigned from Washington or field stations of the department. In all, 135 persons were assigned by bureaus of the department, State colleges, and other State agencies for demonstration and administration.

Summaries containing information as to how exhibits look and what they tell were prepared for 91 of the exhibits used. About 4,000 copies of these summaries, with photographs of striking exhibits, were furnished for use by the publicity departments of fairs. Several news stories were also prepared, and stories were given to

the press at exhibition points. Special news material was furnished to a half dozen free-lance and syndicate writers. Wide distribution was given to department information through these efforts. The preexhibition news items appearing in the daily press were followed by descriptive and informational articles in the farm and rural press.

An exhibition of dairy material was specially prepared for the National Dairy Exposition, held at Indianapolis, Ind., October 10 to 17, 1925. The exhibits were presented and installed by an adequate staff of department employees. It is estimated that 60,000 people visited the exposition, of which probably 90 per cent saw the exhibits. The exhibits occupied about 6,000 square feet of floor space.

Another special exhibition of livestock subjects was made at the International Livestock Exposition, Chicago, Ill., November 28 to December 5, 1925, in the same space as that used annually heretofore. This exhibition was especially successful. Twenty-seven department representatives assisted in its presentation to some 90,000 people who viewed it. The exhibit occupied approximately 9,000 square feet of floor space.

The special exhibition of boys' and girls' club work at the Interstate Fair, Sioux City, Iowa, September 20 to 25, 1925, was seen by about 30,000 visitors. The exhibit portrayed eight outstanding achievements of boys and girls in club work. The interest of many of the visitors was quickened by a voting contest to determine which achievement was considered the most outstanding. This also had the effect of causing a more thorough study of the exhibit by those voting. A floor space of 2,200 square feet was occupied. Three representatives from the department were in attendance, as were extension personnel from several of the States.



An interesting exhibit was prepared and assembled for showing at the Chemical Industries Exposition, New York City, September 28 to October 3, 1925. Information developed by the fixed nitrogen research laboratory and the Bureaus of Agricultural Economics, Animal Industry, Biological Survey, Chemistry, Plant Industry, and Public Roads was made available to some 85,000 people. The exhibit was attended by 13 representatives from the department.

On March 27, 1926, an allotment of \$85,000 was made available to the department for participation in the Sesquicentennial International Exposition, Philadelphia, Pa., which opened June 1. Owing to the short time available, all available department resources of personnel and material were enlisted in the work of assembling, preparation, and installation of the department's exhibit. The office acted as coordinator of the activities of the several bureaus and gave advice and assistance as needed. The director of extension work served as contact officer for the department in relations with the exposition commission.

The building in which the exhibit was to be housed was not completed in time for the opening of the exposition on June 1, and the date for the completion of the installation of exhibits was postponed to July 3. The department's installation progressed rapidly and was practically complete on June 30. Over 100 people were engaged in the collection and preparation of exhibits and in administrative and clerical work in connection with the exhibition. A force of 56 representatives was sent to Philadelphia to install the six carloads of material which made up the exhibits. When installed, a floor space of 28,000 square feet was occupied.

The need for continuous accessibility and movement of exhibits material necessitated the rental of the lower floor of the warehouse at Alexandria. About 20 carloads of material were moved from the upper floor and balconies to the basement. Current exhibits (about 10 carloads) were reboxed during the year so that each exhibit is complete in its own containers. This should reduce handling time and expense considerably. A new system of marking exhibit containers was developed and put into use, designed to prevent confusion and errors.

One of our most difficult problems has been obtaining suitable personnel to conduct exhibitions. Approximately 5,000,000 people annually receive some impression of the department and its work through exhibitions, making their management worthy of the best efforts of the department's most capable people. The installation, dismantling, and shipment of exhibits is a comparatively minor part of the duties of department representatives at exhibitions. The primary duty of these representatives is to extend department information and teach better practices by means of exhibits. The success of the exhibition depends largely upon the ability displayed in using the means available for creating public interest in the information conveyed. Failure properly to handle necessary contacts with the public and cooperators has resulted in the loss of valuable cooperation and endangers the very basis upon which exhibition work is founded. Until such time as suitable personnel is provided, the department can not expect to obtain best results from its exhibition work.

Because of the limitations of our appropriation, which provides specifically for exhibits at State, interstate, and international fairs, it has been necessary to decline invitations to exhibit at 207 occasions of a different character. These occasions embraced such as the following: Farmers' weeks at colleges of agriculture, where farmers gather for the purpose of obtaining information on agriculture; State and national conventions, where conditions for the extension of information are excellent; railroad trains, the railroads offering to bear operating cost of trains on extensive schedules and attending to all organization and publicity work; store windows, bank lobbies, etc., where exhibits could be viewed by large numbers of people at a minimum of expense; county and other fairs and special-subject shows. There are fewer amusements at smaller fairs to invite the attention of visitors, leaving more time for studying educational exhibits.

When feasible, a method of financing exhibitions at such occasions should be provided, preferably by an increase of the exhibits appropriation and a widening of its scope to include them. If this is not possible, a central fund to which contributions would be made by bureaus should be set up, which could be drawn upon as needed for payment of salaries, rental, construction, and renovation costs.

## AGRICULTURAL INSTRUCTION IN SCHOOLS<sup>5</sup>

The work of the office of agricultural instruction, E. H. Shinn in charge, has continued as heretofore with investigations of methods of teaching agriculture in secondary and elementary schools and analyses of certain farm enterprises. Considerable attention was given to the preparation of subject-matter material for use of teachers, the purpose being to suggest improved instruction methods and to aid teachers in the use of lantern slides and other illustrative matter, prepared especially for their needs. Teachers were supplied with classified lists of publications of the department and sources of other useful material. To prepare teaching material in the best form, members of the staff must maintain close contact with the more recent developments in agricultural and home-economics education. The aim is not only to prepare material for teachers, but to bring to their attention useful information accumulated by the department and the agricultural colleges and experiment stations. Close cooperation is maintained with the various subject-matter specialists of the department, from whom much valuable assistance has been received.

A series of 14 educational charts on breeds of livestock was prepared in cooperation with the Bureau of Animal Industry for the use of agricultural and extension teachers. Another series of 18 charts showing important steps in the production and distribution of leading farm crops was prepared in cooperation with the Bureaus of Plant Industry, Agricultural Economics, and Entomology. A series of about 18 additional charts for agricultural and home-economics teachers is in the process of preparation. Numerous requests for the charts and many favorable comments regarding them have been received.

A bulletin entitled "Lessons on Cotton for Elementary Schools" was published and two other bulletins, "Lessons on Corn for Elementary Schools" and "Lessons on Potatoes for Elementary Schools," are in manuscript form. Such publications are

valuable to those who teach agriculture in rural schools, many of whom have not had special training for teaching agriculture and therefore are in need of material on teaching procedure. The requests for material of this kind indicate that it is welcomed by teachers.

Cooperation was continued with the following agencies outside of the department: (1) The Federal Board for Vocational Education, in making studies of the analysis of farm enterprises and in the preparation of publications for the use of agricultural teachers in secondary schools; (2) various States which desired the preparation of courses of study in elementary agriculture for rural teachers; (3) heads of teacher-training divisions in land-grant colleges, who were furnished with lantern slides and sources of other illustrative material and given suggestions on the analyses of farm enterprises for the teaching curricula; and (4) teachers in rural and high schools who were supplied with the results of studies in agricultural education, copies of publications of this department, lantern slides, and classified lists of material prepared especially for their needs.

A study of the analysis of the management of a cotton-growing enterprise was prepared in cooperation with the Federal Board for Vocational Education and published by the board. Practical cotton farmers in Mississippi, Louisiana, and Texas, and cotton specialists in some of the southern agricultural colleges were consulted as to subject-matter content. Criticisms and suggestions were also received from cotton specialists in this department. Another publication for the Federal board on "The analysis of the operative jobs of a corn-growing enterprise" is well under way. These and like publications are used extensively by the heads of teacher-training divisions and by teachers in vocational schools in organizing agricultural courses.

A course of study for Oklahoma rural schools prepared in cooperation with the State department of education and the State Agricultural and Mechanical College of Oklahoma, was published by the latter. A similar course of study for the rural schools of Missouri is in manuscript form and about ready for printing. Considerable progress has been made on a course of study for rural schools of Utah. An outline course of study on agricultural subjects was prepared in

<sup>5</sup>The office of agricultural instruction, previously a detached unit in the office of the Secretary, was attached to the Extension Service by order of the Secretary dated Jan. 15, 1926. The office has continued under the immediate supervision of E. H. Shinn without change in personnel.



cooperation with the State Department of Education of Arkansas for the negro schools in that State. In many of the State courses of study agriculture is receiving greater emphasis than ever before. State officials in charge of rural schools frequently request material for the use of agricultural teachers in rural schools.

Numerous requests have been received from heads of teacher-training divisions for lantern slides and other illustrative material. Members of the staff have visited a number of the teacher-training divisions in the land-grant colleges to give suggestions on the analysis of material on different agricultural subjects.

Teachers in rural elementary and vocational high schools were supplied with lantern slides, classified lists of department publications, and other material. These teachers are anxious to receive assistance from the department. Many requests were received for classified lists of material for agricultural teachers in secondary and elementary schools. The demand from agricultural teachers for lantern slides has been greater than the supply. Efforts are being made to prepare new illustrative material each year for agricultural and home-economics teachers. This work is conducted in close cooperation with the editorial and visual instruction section of the office of cooperative extension work, with specialists on the subjects on which the material is prepared, and with teachers in the field.

Lantern slides were distributed in about three-fourths of the States. A series of lantern slides on school gardening was prepared in cooperation with the supervisors and teachers of nature-study work in the public schools of Washington. The following series of slides were prepared for the use of home economics teachers: (1) Control of household pests detrimental to health and destructive to property. In the preparation of these slides assistance was obtained from the Bureau of Biological Survey and Bureau of Entomology and from the University of Maryland. (2) The equipment used in teaching home economics in negro schools on foods and nutrition, textiles and clothing, and home making and child care. Teachers of home economics in the District of Columbia, in Virginia, North Carolina, and the University of Maryland assisted in the preparation of these slides.

The preparation of two series of lantern slides has been undertaken in cooperation with the Hampton Normal and Industrial Institute and with some of the negro schools in the vicinity of that institution. Negro teachers have made little use of lantern slides of the department. With slides prepared from subject-matter material illustrating negro work, it is believed that greater interest may be aroused among the negro teachers in their use.

Publications giving suggestions on judging dairy cattle, swine, poultry, and beef cattle appear to be greatly needed by agricultural teachers and club leaders. Cooperation has been established with the Bureau of Dairy Industry in the preparation of a publication on "Judging dairy cattle" for the use of those giving instructions in dairy judging.

Cooperation was continued with the Association of Land-Grant Colleges through its committee on instruction in agriculture, home economics, and mechanic arts. Assistance was given to the committee in a study of methods of conducting examinations in land-grant colleges, which was reported at the 1925 meeting of the association. In cooperation with the committee, the topic, "Methods of teaching where subject matter is presented through problems," is now being studied. In connection with other work of the office, visits were made to approximately half of the land-grant institutions, to confer with deans and teachers of agriculture, home economics, and mechanic arts with reference to these studies.

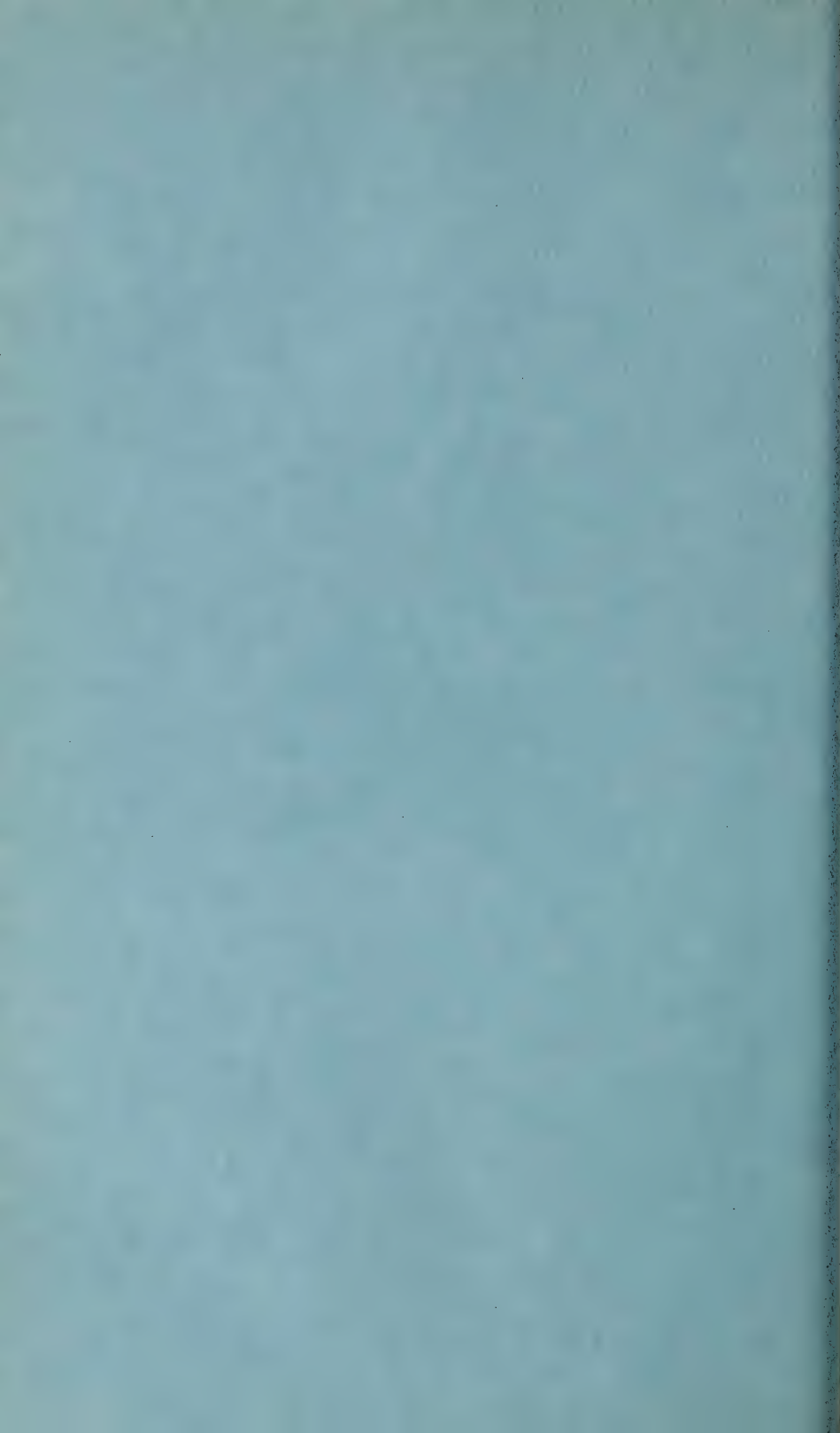
Two exhibit booths for the rural education section of the National Education Association were shown at the Washington meeting of the association. These booths indicated the services the office is prepared to render to agricultural teachers. An exhibit booth was also prepared for the Sesquicentennial Exposition at Philadelphia.

Members of the staff attended the rural education meetings of the National Education Association, National Society for Vocational Education, regional conferences of the Federal Board for Vocational Education, and meetings of the American Country Life Association and the American Home Economics Association, to confer with members of these groups regarding the work of the office. Attendance at these conferences enables the staff to keep in close touch with the latest developments in these fields.











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EXPERIMENT STATION FILE

## REPORT OF THE FEDERAL HORTICULTURAL BOARD

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
FEDERAL HORTICULTURAL BOARD,  
*Washington, D. C., October 14, 1926.*

SIR: I submit herewith an executive report covering the administration of the plant quarantine act for the fiscal year ended June 30, 1926.

Respectfully,

C. L. MARLATT, *Chairman.*

Hon. W. M. JARDINE,  
*Secretary of Agriculture.*

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### INTRODUCTION

During the year the board lost by death W. D. Hunter, one of its representatives from the Bureau of Entomology. This position has been filled by the appointment of J. E. Graf, who, in the Bureau of Entomology, is in charge of the section of truck-crop insect investigations.

The main activities under the plant quarantine act concern: (1) The prevention of entry of new pests with plants and plant products and (2) the prevention of spread within the United States of any such enemies which have gained more or less local foothold. Under the latter, also, falls the administration of special appropriations by Congress for the enforcement of the quarantine restrictions necessary to prevent spread of such pests, and for efforts to reduce or even eradicate them.

The protection of American agriculture from entry of new pests is being secured by the enforcement of some 22 foreign quarantines restricting, controlling, and safeguarding the entry of plants and plant products known to be carriers of specific plant enemies. The spread of new pests within the United States and between the Territories of Porto Rico and Hawaii and the mainland of the United States is being covered by some 17 domestic quarantines. An explanatory list of the current quarantine and other restrictive orders in force is published annually in the Service and Regulatory Announcements. These announcements are issued by the board quarterly, and con-

stitute a permanent record of the new quarantines and of revisions and modifications of those already in force, and of the more important circulars and decisions explanatory of, or bearing on, such quarantines and regulations.

Certain statistical tables not included in the Service and Regulatory Announcements, nor available elsewhere, have been carried over a considerable series of years in the annual report of this board. These tables record the importations of the various plants and plant products the entry of which is restricted and safeguarded under the various foreign quarantines, and constitute a continuing record of distinct value. (See pp. 14-27.)

The control, under specific appropriations, of important new pests which have still only limited establishment within the United States is, as to most of these, carried out by the appropriate bureaus of the department to which these appropriations have been assigned—namely, the Bureaus of Plant Industry and Entomology—but in co-operation with the board and under the authority of the plant quarantine act. It is not necessary in this report to give special note to these bureau projects inasmuch as they will be considered in the reports of the bureaus concerned. Such cooperation with the Bureau of Entomology applies to the quarantines on account of the Mediterranean fruit fly and the melon fly as to Hawaii, the Japanese beetle, the European corn borer, and the gypsy and brown-tail moths; and, with respect to the Bureau of Plant Industry, to the white pine

blister rust and the black stem rust of small grains. On the other hand, the control work with relation to the pink bollworm of cotton, to the date scales and to the *Thurberia* weevil in Arizona—a new item—is conducted under appropriations assigned directly to this board. A somewhat more detailed report of the work under these latter projects is pertinent to this annual report as not being recorded elsewhere.

### STATUS OF THE CONTROL OF THE PINK BOLLWORM

The pink bollworm project suffered an irreparable loss in the sudden death October 13, 1925, already referred to, of W. D. Hunter. Doctor Hunter had been in continuous field charge of this project from the discovery of this pest in the South, and under his able leadership the pest had been eradicated from the extensive foothold which it had gained in the Cotton Belt proper and was being successfully held in check in the western areas of infestation. Following his death, the field direction of the project was continued until July 1, 1926, under the direction of F. S. Puckett, who had been the administrative assistant to Doctor Hunter for several years, and who was thoroughly familiar with the work, especially in its regulatory phases. To give the whole project, however, the benefit of technical direction of a highly trained specialist, the services of George G. Becker, chief inspector, State Plant Board of Arkansas, were obtained and he has been in general field charge of the project beginning with July—Mr. Puckett remaining as second in charge and having immediate supervision of the regulatory phases of the work.

The most important feature of the pink bollworm situation during the last fiscal year has been the continued freedom of the very important cotton regions of central and eastern Texas and Louisiana, which were formerly widely infested with this pest, indicating the continuing benefit and success of the eradication and control measures which have been carried out as to those areas. Inasmuch as the pink bollworm is believed, on its record in other countries, to exceed in its possibilities for damage even the Mexican boll weevil, it would seem reasonable to indicate that the benefit of this eradication and control to the cotton crop of America has an insurance value of possibly 1,000 to 1 over the actual moneys expended to insure this result. These expenditures have averaged less than \$300,000 annually, and

the losses from the boll weevil have, in bad years, possibly exceeded \$300,000,000.

As in the case of last year, the pink bollworm has been held to the areas in the upper Rio Grande and Pecos Valleys in western Texas and New Mexico, where, for the present at least, there seems to be no possibility of eradication—certainly as to the Rio Grande areas. This result has been achieved by quarantining the infested areas and controlling and safeguarding the movement therefrom of carrying products, including both cotton and other farm products and farm machinery, household goods, etc., and so far spread has been prevented eastward into the main Cotton Belt and westward into Arizona and California. The increasing complexity of this problem and the necessity for strenuous enforcement of all possible safeguards if spread is to be prevented is fairly clearly brought out in the following more detailed discussion of the pink bollworm situation.

As to the infested western areas, the important developments during the year are (1) the rediscovery of the insect in the Mesilla Valley for the first time since 1922, (2) the rediscovery of the insect in the Pecos Valley of New Mexico for the first time since 1921 and the extension of the infestation in that valley to a point 40 miles north of the 1921 infestation, (3) the discovery of a number of isolated infestations located from 35 to 50 miles from any other known infestation, (4) the increased destructiveness of the insect in the Big Bend and in the El Paso Valley, and (5) the discovery of insect injury at Odessa, Tex., having all the characteristics of pink bollworm injury.

The accompanying map is introduced to indicate graphically the infested areas in western Texas and New Mexico, and the relation of these areas to the western extension of the main Cotton Belt. It also indicates the road-inspection stations and the location of the vacuum fumigation plants.

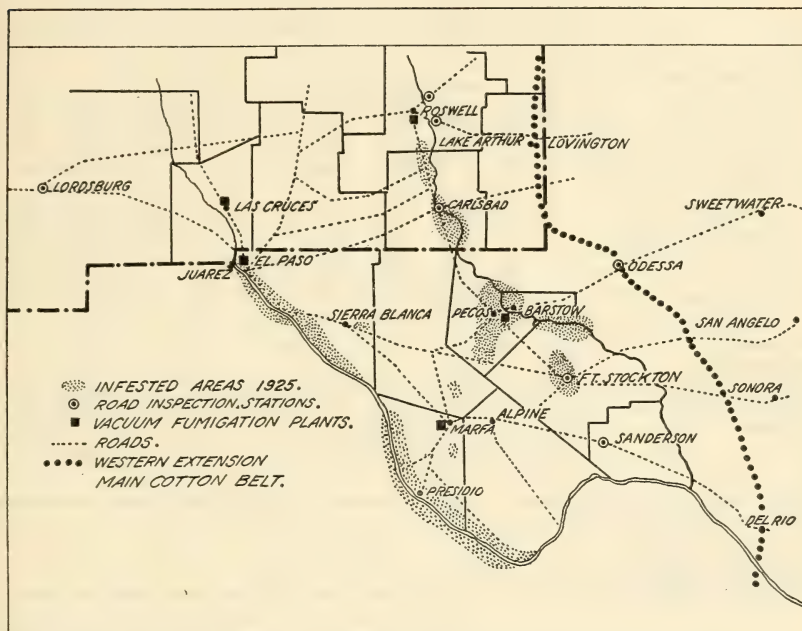
### DENSITY, RANGE, AND FLUCTUATIONS OF INFESTATIONS

New high records for destructiveness of the pink bollworm and density of infestation were established for the crop year of 1925. In the Laguna district of Mexico there was an average loss of 31.8 per cent of the cotton crop due to the activities of this pest. In the Big Bend of Texas damage ran as high as 25 per cent of the crop.

The Rio Grande infestations including the Mesilla and El Paso Valleys, the Big Bend of Texas and Mexico, and the Juarez Valley of Mexico may now be regarded as a continuous infestation extending from Santa Helena to a point about 7 miles north of El Paso, a distance of approximately 300 miles.

New Mexico notwithstanding the fact that no worms had been found since 1921.

Most significant are the fluctuations in density of infestations from year to year. This is especially well illustrated by the intensive inspections which have been made each year since 1920 on the



Areas in western Texas and New Mexico infested with pink bollworm, crop of 1925.

Infestations occur on both the Texas and Mexican sides of the river wherever cotton is grown. About 110,000 acres are involved. The infestation throughout this region is heavier than ever before and gives every indication of being more settled and permanent. In the El Paso Valley, for instance, while only one infested field was found each year for 1923 and 1924, infestation for the crop year 1925 was general and ran as high as 10 per cent in one field where no infestation was found last year.

In the Pecos Valley of New Mexico and Texas infestation is now general from Buena Vista, Tex., to Lake Arthur, N. Mex., a distance of about 175 miles. The Pecos Valley infestation consists of four areas more or less separated by desert regions. About 87,000 acres are involved. Of particular interest in connection with this infestation is the light but general distribution of the insect in this valley in

Ivy-Dale ranch in the El Paso Valley. Following is a summary of this work:

Year	Specimens per man-day scouting
1920.....	0.09
1921.....	2.94
1922.....	1.38
1923.....	0.00
1924.....	0.04
1925.....	4.67

Fluctuations in the range of infestations in the various districts is fairly well indicated by the number of infested fields found and the number of man-days scouting done to find these infestations. See Table 1. These fluctuations emphasize the danger of giving too much consideration to negative findings in scouting work.



TABLE 1.—Summary of pink bollworm scouting showing number of man-days scouting and number of infested fields for each of the districts scouted

District	1917		1918		1919		1920		1921		1922		1923		1924		1925	
	Man days	Infested fields	Man days	Infested fields	Man days	Infested fields	Man days	Infested fields	Man days	Infested fields	Man days	Infested fields	Man days	Infested fields	Man days	Infested fields	Man days	Infested fields
<b>The eradication areas:</b>																		
Hearne, Tex. ....	164	5	471	0	650	0	505	0	369	0	172	0	255	0	0	0	0	0
Trinity Bay, Tex. ....	645	156	829	0	1,796	51	2,006	28	1,518	1	891	0	1,225	0	1,046	0	787	0
Ennis, Tex. ....	0	0	0	0	0	0	0	0	798	5	671	0	740	0	835	0	606	0
Marilee, Tex. ....	0	0	0	0	0	0	0	0	340	2	461	0	611	0	612	0	237	0
Cameron, La. ....	0	0	5	0	104	22	213	0	319	0	632	0	718	0	655	0	649	0
Shreveport, La. ....	0	0	0	0	46	0	486	10	320	0	332	0	648	0	826	0	606	0
<b>The infested areas:</b>																		
Pecos Valley, N. Mex. <sup>1</sup> .....	0	0	111	0	57	0	310	2	63	4	282	0	1,212	0	741	0	626	16
Pecos Valley, Tex. ....	0	0	555	9	1,123	1	850	15	299	21	386	0	421	5	650	15	183	22
Mesilla Valley, N. Mex. ....	0	0	0	0	0	0	210	4	20	3	65	0	231	0	158	0	155	0
Mesilla Valley, Tex. ....	0	0	0	0	0	0	30	1	7	3	12	1	0	0	140	0	17	1
El Paso Valley, Tex. ....	0	0	103	0	158	0	339	14	78	9	261	4	406	1	397	1	131	14
Big Bend, Tex. ....	0	0	4	18	( <sup>2</sup> )	1	( <sup>3</sup> )	0	22	11	27	24	66	36	167	62	( <sup>4</sup> )	96
Big Bend, Mexico. ....	0	0	( <sup>5</sup> )	3	( <sup>5</sup> )	0	( <sup>2</sup> )	0	( <sup>5</sup> )	1	0	0	2	3	( <sup>5</sup> )	2	0	0
Juarez Valley, Mexico. ....	0	0	( <sup>5</sup> )	0	0	0	0	0	0	0	5	1	0	0	0	0	2	3
San Carlos, Monclova, Mexico. ....	( <sup>5</sup> )	4	( <sup>5</sup> )	2	17	6	( <sup>5</sup> )	1	48	7	5	2	26	0	40	0	37	0
<b>Suspicious areas:</b>																		
Western extension. ....	0	0	16	0	105	0	123	0	463	0	120	0	39	0	16	0	746	0
Lower Rio Grande, Tex. ....	9	0	107	0	156	0	279	0	520	0	718	0	881	0	354	0	886	0
Lower Rio Grande, Mexico. ....	0	0	0	0	30	0	0	0	131	0	0	0	35	0	34	0	16	0
Other areas <sup>6</sup> .....	366	0	1,278	0	1,375	0	2,663	0	4,143	0	2,720	0	1,860	0	777	0	687	0
<b>Total</b> .....	1,184	165	3,479	32	5,617	81	8,014	75	9,458	67	7,760	32	9,376	45	7,448	80	6,371	152

<sup>1</sup> Infestation in this valley was confined in the past to Carlsbad and vicinity and is referred to in previous reports as "Carlsbad" infestation.

<sup>2</sup> 0.5 man day or less.

<sup>3</sup> Noncotton zone year.

<sup>4</sup> Research examinations.

<sup>5</sup> Figures not available.

<sup>6</sup> Covers scouting done around centers in the Cotton Belt to which seed from infested areas was traced.

Other important information brought to light by the 1925 scouting was the turning up of three isolated infestations at distances ranging from 35 to 50 miles from infested cotton. Whether these isolated infestations arose through the planting of treated seed in which worms were supposed to have been killed by the heating process or whether the insect spread from the infested areas through other means can not be definitely stated. Of interest in connection with the Fort Davis finding is the fact that in January when the infested bolls were found the living worms must have survived a temperature of 10° F.

#### OTHER SCOUTING WORK

The continued narrowing of the natural noncotton zone existing between the Pecos Valley infestations and the western extension from central Texas of practically continuous cotton production offers a most menacing situation. The growing of cotton by dry-land farming methods has nar-

rowed this noncotton zone until there are only about 35 miles intervening between some of the Pecos Valley infestations and the western extension. A total of 746 man-days scouting was done along this western extension. At Odessa, Tex., insect injury was found which had all of the characteristics of pink bollworm injury. Three hundred and five man-days scouting was done in this vicinity without discovering any pink bollworms. A thorough clean-up was made of 1,300 acres in this suspicious area.

The lower Rio Grande Valley from Del Rio to Brownsville offers another very menacing problem. Mention has been made, in previous reports, of cotton from infested fields being washed down the river. In addition to this, the unsatisfactory regulation of the movement of materials likely to carry infestation into the Matamoros district from infested areas in other parts of Mexico presents another danger. The significance of the establishment of an infestation in the lower Rio Grande Valley becomes apparent when

it is realized that cotton production is more or less continuous from this region into the Cotton Belt proper. Eight hundred and eighty-six man-days scouting was done on the Texas side of the lower Rio Grande Valley and fifty-three man-days scouting was done in the scattered plantings on the Mexican side without yielding signs of infestation.

In the cotton plantings of the border counties of Arizona 356 man-days scouting was done without revealing any signs of the pink bollworm.

#### THE ERADICATION AREAS

Continued scouting in the areas of central and eastern Texas and western Louisiana in which the board has undertaken to eradicate the pink bollworm yielded no findings which would in any manner question the efficacy of the eradication work done in those areas. The status of these various areas is given in Table 2:

TABLE 2.—*Number of crop seasons which have elapsed since the last infestation was discovered in each district*

District	Date of last infestation found	Crop seasons elapsed since last infestation found	Man-days scouting since last infestation
Texas:			
Hearne....	Sept. 24, 1917	8	2,430
Trinity			
Bay.....	Sept. 23, 1921	4	4,913
Ennis.....	Nov. 2, 1921	4	2,962
Marilee...	Nov. 13, 1921	4	2,313
Louisiana:			
Cameron...	Feb. 27, 1920	6	3,194
Shreveport....	Dec. 13, 1920	5	2,766

A total of 6,371 man-days scouting was put in on all of the various pink bollworm scouting projects covering the 1925 crop.

#### ROAD STATIONS

The continued increase in automobile traffic with the attendant danger of spreading infestation through the movement of infested material was indicated by the interceptions made at the road stations leading out of the infested areas. Stations are at present being maintained at Lordsburg, Roswell, and Carlsbad, N. Mex., and at Odessa, Fort Stockton and Sanderson, Tex. A total of 60,911 cars were inspected from which 2,340 lots of cottonseed, seed cotton, cotton picker's sacks

and other materials likely to carry infestation were intercepted. One thousand seven hundred and forty-nine lots of material likely to carry other pests were also intercepted.

#### VACUUM FUMIGATION

Under the amended pink bollworm quarantine vacuum fumigation of all cotton lint and linters is required as a condition for the movement of these products out of the infested areas. Vacuum fumigation plants have been erected at Roswell and Las Cruces, N. Mex., and at Pecos, Marfa and El Paso, Tex. At these plants a total of 84,539 bales of cotton lint and linters were fumigated of which 1,111 were of Mexican origin.

#### SEED HEATING

Under both Texas and New Mexico regulations cottonseed is required to be heated as a continuous process of ginning in order to kill pink bollworms which might be present. In another part of this report attention is called to isolated infestations which might have been introduced as a result of the improper functioning of these machines. Considerable progress has been made to obtain more efficient operation of these machines as is indicated by the fact that in 1925 they were operated at an average efficiency of 87.2 per cent as against 70 to 80 per cent efficiency for the preceding year.

#### INVESTIGATIONS

During the year some investigations were started to determine what were favorable and what were unfavorable conditions for the hibernation of the pink bollworm in the Big Bend area. Considerably more work will have to be done in this direction before dependable conclusions can be drawn. A study of the malvaceous plants in the infested areas is now being made to determine the possibility of the pink bollworm's adaptability to these plants.

Some preliminary investigations in vacuum fumigation indicate the desirability of further tests to determine optimum conditions and the most efficient type of machinery for this work. An interesting result incident to the fumigation tests was the high mortality of pink bollworm larvæ in bales of cotton which had been compressed. Seeds infested with worms when placed in the center of the bales were repeatedly crushed so that 100 per cent of the worms were killed.

The increase in efficiency which has resulted from the careful investigation



which is now in progress of seed-heating machinery has already been referred to.

#### COOPERATION WITH MEXICO

Mention should be made of the co-operation with Mexican authorities which should be of great help in strengthening the pink bollworm project. Besides the scouting work done in Mexico, aid has been given in improving the heating machinery in operation in areas from which infestation is likely to spread to the United States. The secretary of agriculture of Mexico has also been induced to recommend the erection of houses for the fumigation of all railroad cars moving out of the infested regions of Mexico. If this recommendation is acted upon the danger of introducing the insect into such border districts as Matamoros and thence to the lower Rio Grande Valley in Texas will have been greatly reduced.

#### REGULATIONS AMENDED

Under the provisions of the revision of Quarantine No. 52 effective March 1, 1926, the regulated areas of Louisiana and of central and eastern Texas were released from restrictions contingent upon the continued freedom of those areas from this pest. The counties of Curry, Roosevelt, Lea, Quay, and Union of New Mexico were released under the same conditions because of failure to find infestations in those counties.

Provision is also made for the vacuum fumigation of all forms of cotton lint, linters, and other forms of cotton lint as a condition of interstate movement of these products from the infested areas. Similarly intrastate movement is controlled under State quarantine.

The pink bollworm regulations of the State of Texas were amended to conform to recommendations of the board at its conference held at El Paso, Tex., in April, 1925.

#### DATE-SCALE ERADICATION

This work seems to be in a very satisfactory status, and particularly with respect to the commercial properties, including the larger date orchards, the owners of which are giving good cooperation in the eradication effort. The chief difficulty now comes from house owners in villages and towns who have only a few date palms in their dooryards, trees which are primarily of value as ornaments, and, therefore, the owners are apt to object strongly to drastic treatment. Much of the delay, therefore, in

eradication has been due to such dooryard infestations which can not always be subjected to the radical handling which is given in commercial orchards. Nevertheless, very satisfactory progress has been made, but it is evident that the work will have to be maintained for several years longer before success is achieved. This project is being conducted in cooperation with the Bureau of Plant Industry, and the bureau experts in charge are thoroughly hopeful and sanguine that the scale can be eradicated and that each year sees a much closer approximation to that end. The necessity for the eradication of this scale seems to be clearly shown by recent reports of damage from it in parts of the Sahara Desert where, as reported by Mr. Swingle, in the case of new invasions unchecked by any natural enemies it has rendered the trees sterile in 3 or 4 years and killed most of them within 10 years.

The investigation of the life-history work which is being conducted in co-operation with a specialist loaned by the Bureau of Entomology has immensely aided the eradication of the *Parlatoria* and has made discoveries of fundamental importance in the control and eradication of other dangerous insect pests of the date palm. It will be recalled that this control work involves date plantings in three States—California, Arizona, and Texas—and that except for very local, and, in some sense, trivial infestations, the commercial plantings in these States are now free from *Parlatoria*.

#### THE THURBERIA WEEVIL QUARANTINE

The *Thurberia* weevil—apparently a mere biological race of the Mexican cotton boll weevil—is undoubtedly native and has long occurred in the mountains of southern Arizona, attacking the *Thurberia*, a plant which is distantly related to cotton, and which grows abundantly in the canyons of these mountains. The potential importance of the *Thurberia* weevil as an enemy of cotton was recognized several years ago, or as soon as this weevil was discovered in the mountains of Arizona in the neighborhood of Tucson, and various preliminary studies were made of it, indicating its very close relationship to the Mexican cotton boll weevil and the possibility of its attacking cultivated cotton. A specific appropriation of \$7,500 to continue and enlarge such studies was obtained by the Bureau of Entomology of this department. The investigational work conducted prior to and



under this appropriation has demonstrated that the *Thurberia* weevil will attack cultivated cotton as readily as the ordinary boll weevil and that freshet water from the mountains may be expected to carry the weevil in numbers to any cotton grown in the intervening valleys. In the last few years the production of cotton in this region has been rather generally undertaken, with the result that the *Thurberia* weevil has become more or less established in cotton in the valley of the Santa Cruz River from some distance north of Tucson nearly to Nogales.

The particular menace of this weevil is its acquired ability to thrive under the hot, arid conditions which are found in western Texas and Arizona, as well as in California—conditions which have hitherto formed an absolute barrier to the westward spread of the Mexican boll weevil. The important determination made in connection with the studies of the *Thurberia* weevil in the fall and winter of 1925-26 is that, reaching cultivated cotton from neighboring canyons, it can maintain itself on such cotton without the necessity of renewal each year from mountain sources. If such renewals were essential, the pest might have a very minor importance and be subject to easy control, and present little menace of spread. Its behavior during the winter referred to, however, demonstrated that it can hibernate in cultivated cotton, not only successfully, but with scarcely any mortality, whereas the Mexican boll weevil in its range from central Texas eastward, suffers a high percentage of winter mortality. This indicates that the *Thurberia* weevil may become even more injurious in the more arid regions of cotton culture than the Mexican weevil in the main Cotton Belt.

The menace of this pest to the very important cotton development from central Texas westward having thus been fully established, a hearing to consider the advisability of establishing a Federal quarantine, to be the basis of control and prevention of spread of the weevil, was held in Washington June 1, 1926. As a result of this hearing, quarantine No. 61 was issued, effective July 15, providing for restrictions on the movement of any material from Arizona capable of carrying the *Thurberia* weevil, and other provisions similar to those enforced to prevent the spread of the pink bollworm from west Texas to other cotton areas. It is expected, with the cooperation of the State of Arizona and under a State quarantine, to be able to extend similar

protection to the important cotton areas in the Salt River Valley and elsewhere in that State, beyond the present known range of the weevil.

For the enforcement of this quarantine and the necessary surveys to determine the boundaries of the areas to be specifically covered and declared to be infested, authority was given the department by Congress in the second deficiency act to use from the appropriation for the eradication of the pink bollworm up to \$35,000. An additional appropriation of \$15,000 was made to the Bureau of Entomology for research work including the surveys in Arizona necessary to determine local spread as a basis of readjusting, as necessary, the areas within that State to be designated as infested.

### PLANT QUARANTINE ACT AMENDED

By joint resolution (Public Resolution No. 14, 69th Congress), the Federal plant quarantine act was amended to allow the States to quarantine against the shipment therein or through of plants, plant products, and other articles found to be diseased or infested when not covered by a quarantine established by the Secretary of Agriculture, and for other purposes. The necessity for this amendment arose from the decision of the supreme court of March 1, 1926, in the case of the Oregon-Washington Railroad & Navigation Co. versus the State of Washington, which in effect ruled that, with the Federal plant quarantine act in force, "State action is illegal and unwarranted." This ruling invalidated upward of 200 State quarantines, and necessitated an amendment of the plant quarantine act to make it possible for any State to take protective action with respect to any plant pest which had not been specifically covered under a Federal quarantine. A joint resolution was, therefore, drafted, amending section 8 of the Federal plant quarantine act to give such powers to the several States. This amendment received the sanction of Congress, and was approved by the President, April 13, 1926. The amendment also authorizes the Secretary of Agriculture to cooperate with any State, Territory, or district in the enforcement of any such quarantines and, further, gives authority for any State to exercise its police powers with respect to any articles shipped in violation of a Federal plant quarantine. These provisions for cooperation in plant quarantine activities—Federal and State—will greatly strengthen and harmonize such action in the future.

## INSPECTION AND CERTIFICATION OF PLANTS AND PLANT PRODUCTS FOR EXPORT

Authority was granted in the act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1927, "to inspect, under such rules and regulations as the Secretary of Agriculture may prescribe, domestic fresh fruits, vegetables, and seeds, and nursery stock and other plants for propagation, when offered for export, and to certify to shippers and interested parties as to the freedom of such products from injurious plant diseases and insect pests according to the sanitary requirements of foreign countries, and to make such reasonable charges and to use such means as may be necessary to accomplish this object."

The Federal Horticultural Board has been charged with the duty of such inspection under an initial appropriation of \$10,000.

It is expected that this new service will be self-supporting under the authority granted to make reasonable charges for inspection and certification—the receipts for the first month totaling nearly \$4,000. If, however, the present volume of exports requiring such inspection is even approximately maintained during the year, this service will call for an annual expenditure of from \$30,000 to \$40,000.

The need for authority for such inspection arose from the fact that an increasing number of foreign countries are requiring certification that the consignments are free from disease and pests. Up to this year there has been no authority for making such inspections or issuing such certificates. Hitherto, by arrangements with State officials, in some instances it has been possible to have State certificates issued, and in other instances certification has been made through the food products inspection force of the department or the Federal Horticultural Board. Such makeshifts have been most unsatisfactory to this department, to the foreign countries concerned, and to the exporters, involving for the latter often very considerable delays. Furthermore, exporters expressed a willingness to assume on a fee basis the expense of the maintenance of a regular and adequate service. Definite authority for such service, to be carried out by competent specialists at the cost of the exporter, was therefore requested and granted. Under date of August 9, 1926, rules and regula-

tions governing such inspection and certification and fixing the charges therefor, were issued by the Secretary of Agriculture and became immediately effective.

## THE NARCISSUS BULB QUARANTINE

Considerable interest developed during the year relative to the proposed restriction on the importation of narcissus bulbs. It will be recalled that in 1922, following a hearing on the subject, the entry of narcissus bulbs was ordered brought under restriction effective January 1, 1926, and the approach of this date led to a considerable agitation of the subject, and eventually the calling of a new hearing which reopened the subject for discussion and decision. As a result of the information brought out at this hearing, the action taken by Secretary Wallace was reaffirmed as to the narcissus bulb by Secretary Jardine. This action excluded the commercial entry of narcissus bulbs for immediate sale or for forcing for cut flowers, but left open the provisions for entry under regulation 14 of quarantine 37 for the purpose of keeping the country supplied with new varieties and necessary propagating stock, or for any necessary experimental, educational, or scientific purpose. The entry of such bulbs was furthermore safeguarded by the requirement of disinfection, either at port of entry or at destination. The object of these restrictions, and the requirement of disinfection, was a part of the program looking to the eradication, if possible, in the United States of the more important bulb pests—pests which were of significance not only to bulbs but also to other cultivated crops. To extend similar safeguards to narcissus bulbs grown in the United States, including disinfection of any infested lots of bulbs, as a condition of interstate shipment, a domestic quarantine covering the subject was promulgated. The enforcement of this quarantine and the supervision of the required treatments is being carried out under the cooperation of the plant quarantine inspection services of the several States. Incidentally, it may be noted that the production of narcissus bulbs has been undertaken widely in the United States and in amounts to indicate the availability in one or two years of bulbs very much in excess of former importations—bulbs which it is hoped, by the measures referred to, will be free from risk of carrying infestation of bulb pests to bulb plantings or other crops.



## EMBARGO ON SPANISH GRAPES REAFFIRMED

At the request of the Department of State, the chairman of the Federal Horticultural Board, in cooperation with the Spanish officials and Almeria grape growers, made, during the month of August, 1925, a reinvestigation in Spain of the Mediterranean fruit fly situation. The chairman also discussed fully with these officials and persons in interest the possibilities of a modification of the embargo. (See Service and Regulatory Announcements for 1925, pp. 73 and 74.) The later consideration by the Department of Agriculture of the basis suggested for such modification developed that no acceptable guarantees could be given that the controls essential to the elimination of risk could be fully carried out, and the department was, therefore, in view of the enormous menace of this pest to the fruit interests of the United States, unable to accept these proposals, and the embargo was reaffirmed. (See Service and Regulatory Announcements for 1925, pp. 101 and 102.)

## TERMINAL INSPECTION OF MAIL SHIPMENTS OF PLANTS AND PLANT PRODUCTS

During the year the State of Oklahoma inaugurated terminal inspection of mail shipments of plants and plant products under the authority of the act of March 4, 1915, while the terminal inspection points in Georgia and California were revised. California, Arizona, Montana, Florida, Washington, Arkansas, the District of Columbia, Mississippi, the Territory of Hawaii, Utah, Oregon, Georgia, and Idaho, in the order named, had previously availed themselves of the provisions of the act referred to.

## CONVICTIONS AND PENALTIES IMPOSED FOR VIOLATIONS OF THE PLANT QUARANTINE ACT

The following convictions and penalties imposed for violations of the plant quarantine act were reported to the board during the year:

White pine blister-rust quarantine (No. 26).—Twenty-seven convictions, with fines aggregating \$549 and costs imposed.

Japanese beetle quarantine.—Eight convictions, with fines aggregating \$405 imposed.

Mexican fruit fly and other quarantines affecting Mexican products.—Ten convictions, with fines aggregating \$270 imposed.

Mediterranean fruit fly and melon fly quarantine.—Two convictions, the defendant in one case being sentenced to serve 90 days in jail and in the other case to serve 24 hours in jail.

Fruit and vegetable quarantine.—Five convictions, three of the defendants being sentenced to serve 60 days in jail, while the other two were sentenced to serve 37 days in jail.

## NEW AND REVISED PLANT QUARANTINES AND OTHER RESTRICTIVE ORDERS

The following quarantines and other restrictive orders have been either promulgated or revised during the year:

### DOMESTIC QUARANTINES

The pink bollworm quarantine, amended November 25, 1925, to provide for disinfection of baled cotton lint and linters grown in a regulated area in which the crop under consideration or either of the two preceding crops has been found to be infested, and revised February 26, 1926, to require vacuum fumigation of cotton lint, linters, and cotton samples moving interstate from an infested area; providing for interstate movement for disinfection of baled cotton lint, linters, gin waste, and all other forms of cotton lint, including samples, under permit from one regulated area to another regulated area, and releasing from quarantine the regulated areas in Louisiana and central and eastern Texas and the counties of Curry, Roosevelt, Lea, Quay, and Union, N. Mex.; the gypsy moth and brown-tail moth quarantine, amended October 14, 1925, releasing two towns in Connecticut from quarantine, and revised May 15, 1926, releasing from the quarantine restrictions certain areas in Connecticut, Massachusetts, and Vermont; the satin moth quarantine, revised November 3, 1925, to include States of Maine, Rhode Island, and Washington, and extending areas in New Hampshire and Massachusetts designated as infested; the Japanese beetle quarantine, amended December 23, 1925, extending the regulated area, and revised April 26, 1926, extending the regulated area and giving authority to require, as a condition of interstate movement, the protection from beetle infestation of the articles covered by this quarantine originating within or being transported



through the regulated area during the period June 15 to October 15, inclusive; the European corn borer quarantine, amended January 4, 1926, to include additional infested territory; the Hawaiian and Porto Rican quarantine covering sand, soil, or earth, with plants, promulgated February 19, 1926; the *Thurberia weevil* quarantine, promulgated July 2, 1926; and the domestic narcissus bulb quarantine, promulgated July 3, 1926.

#### FOREIGN QUARANTINES

The flag-smut quarantine, promulgated December 31, 1925, prohibiting importation from India, Japan, China, Australia, Union of South Africa, Italy, and Spain of all species and varieties of wheat and wheat products, except such as have been so milled or so processed as to have destroyed all flag-smut spores; the European corn borer quarantine, revised April 23, 1926, removing the restrictions formerly enforced on the entry of certain vegetables, cut flowers, and flowering plants from the Province of Ontario, Canada; and the nursery stock, plant, and seed quarantine, amended December 31, 1925, to provide for the exclusion of narcissus bulbs except for propagation purposes.

#### OTHER RESTRICTIVE ORDERS

The cottonseed-products regulations, amended August 7, 1925, so as to provide for greater freedom of entry from Mexico.

### PLANT QUARANTINE INSPECTION

#### EXTENT OF FIELD

The plant quarantine inspection service is charged with enforcement at maritime and interior ports of entry, including Washington, of all foreign and a number of the domestic quarantines promulgated under the plant quarantine act of 1912. This work involves: (1) The inspection of vessels arriving at ports of entry from foreign ports and from Porto Rico and Hawaii; (2) the inspection and disposition of all plants and plant products under restriction found in passengers' baggage by the United States customs officials; (3) the inspection of all plants and plant products, including nursery stock, seeds, bulbs, fruits, and vegetables entered under permit from all foreign countries and localities and certain products arriving from domestic territory; (4) disinfection (fumigation or sterilization) of cotton and broomcorn and other products requiring such treat-

ment as a condition of entry; (5) inspection, in cooperation with customs and post-office officials, of restricted plants and plant products arriving by foreign parcel post; (6) inspection of plants and plant products introduced by the Department of Agriculture and all plants imported under special permit in accordance with the provisions of regulation 14, quarantine 37; (7) inspection of plants (domestic) entering and leaving the District of Columbia; (8) inspection of plant introduction gardens of the Bureau of Plant Industry; (9) inspection of fruits and vegetables in the field and at the point of shipment in Porto Rico, in accordance with the provisions of quarantine 58. This inspection work is summarized below under appropriate headings.

#### MEXICAN BORDER SERVICE

The principal object of the Mexican border service is the prevention of further entry of the pink bollworm from Mexico into the United States. On account of the very general fouling of Mexican cars with cottonseed, often infested with bollworm larvæ, it is necessary to inspect and, as a rule, to supervise the cleaning and disinfection of all cars, freight, express, baggage, and other materials entering from Mexico. For this purpose, inspectors are stationed at eight Mexican border ports. At two of these ports—Del Rio and Calxico—where there are no rail connections with the interior of Mexico, the inspectors are engaged in the examination and, if necessary, disinfection of vehicular traffic.

At the five ports of entry having rail connections with the interior of Mexico, fumigation houses, having a capacity of from 4 to 20 freight cars, are maintained. The inspection of cars is made in the Mexican port opposite the American port of entry and all cars fouled with cottonseed are thoroughly cleaned by the railway company before entry is authorized. It is realized that this inspection will not reveal all cottonseed which may be concealed behind the linings of the cars, and all cars originating in certain infested districts of Mexico are fumigated immediately upon crossing the international boundary. A charge of \$4 per car is made, and all fees collected are turned in to the Treasury as miscellaneous receipts. A record of this work is given in Table 3.

In addition to the above, this border service cooperates with the Customs Service in the footbridge and line

inspection of baggage and personal effects, and with the Post Office Department in the examination of mail packages, for the purpose of enforcing various other plant and plant product quarantines. Such inspection results daily in the interception of fruits, such as mangoes, peaches, oranges, etc., which may be the means of introducing the Mexican fruit fly; avocados infested with the avocado weevil; and plants restricted entry on account of other insects and of plant diseases. Even the personal effects of immigrants and others present a risk and require inspection and, if necessary, disinfection. Pillows and mattresses stuffed with cotton brought by Mexican laborers entering this country frequently contain living pink bollworms with included cotton seed. To avoid the necessity of confiscating such material, arrangements have been effected with the Public Health Service to sterilize it with live steam under pressure, preceded by a partial vacuum. Table 4 indicates, either by pounds or by individual units, such contraband material intercepted in the possession of individuals crossing from Mexico. Thousands of interceptions are indicated by the figures in this table, since the individual interceptions are as a rule only of from one to a dozen plants or fruits, etc.

TABLE 3.—*Inspection and fumigation of railway cars crossing the border from Mexico, 1926*<sup>1</sup>

Port	Cars inspected	Cars fouled with cottonseed	Cars fumigated	Fees collected and turned into the treasury
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Dollars</i>
Brownsville.....	454	138	2 487	1, 948
Laredo.....	9, 165	1, 283	7, 951	32, 452
Eagle Pass.....	4, 541	1, 558	2, 861	11, 464
El Paso.....	7, 769	224	3, 725	15, 504
Douglas <sup>2</sup> .....	2, 956	108		
Nogales.....	10, 818	182	3, 817	15, 268
Total.....	35, 703	3, 493	18, 841	76, 636

<sup>1</sup> This table does not include the results of the work performed at Del Rio, Tex., since there are no railroad connections with Mexico at that point. Inspectors are stationed here, however, and 19,841 vehicles of various descriptions were inspected, 35 of which were fouled with cottonseed. Thirty-three vehicles were fumigated, for which fees amounting to \$16.50 were turned into the treasury.

<sup>2</sup> Of this number, 33 were fumigated prior to entering Mexico.

<sup>3</sup> No fumigation facilities at this port at present.

<sup>4</sup> The apparent discrepancy in the fees collected and the number of cars fumigated may be explained by the fact that it is customary to purchase fumigation coupons in advance.

TABLE 4.—*Contraband plants and plant products intercepted at Mexican border ports, 1926*

(Unless otherwise stated, the numerals indicate the number of specimens intercepted)

Commodity	Brownsville	Eagle Pass	Del Rio	Laredo	El Paso	Nogales	Douglas
Apples.....		307	25	1, 784	1, 819		272
Apricots.....		119		89	98		15
Avocados.....	643	439	39	2, 021	765	370	
Avocado seed.....			18	103	94		
Banana plants.....		1		309	9	212	
Cherimoyas.....		1		31	65		
Cherries.....				60			
Corn, dry.....							
pounds.....	572	1, 086	31	1, 527	73	887	207
Corn husks.....							
pounds.....		122		68	18		25
Corn ears, green.....		149			249		458
Cotton bolls.....					144		
Cotton lint.....							
pounds.....	464	79		34	98	303	
Cotton seed.....							
pounds.....			2	1	24		
Figs.....		1, 349		2, 653	1, 486		299
Grapefruit.....	70	16		156	11	187	1
Grass, pounds.....		30	126	320	10		
Guavas.....	102	78		885	605	412	
Limes, sweet.....	19	1, 198	3	880	711	537	51
Mameys.....		25		43	207		
Mangoes.....	187	37	5	556	361	235	83
Mattresses, cotton.....							
pounds.....			15				9
Oranges.....	502	702	64	3, 439	1, 191	1, 309	824
Papayas.....							
pounds.....							1
Peaches.....	292	387	164	1, 457	958	1, 380	598
Pears.....		64		691	1, 067		97
Persimmons.....					6		
Pillows, cotton.....			28	7			
Plants.....	2, 089	740	112	5, 762	1, 205	2, 724	795
Plums.....	151	46		242	341	31	1
Pomegranates.....		395	35	802	108		42
Potatoes.....	328	243	20	361	40		120
Quilts, cotton.....			50	7			27
Quinces.....		230	86	980	1, 053		115
Sapotes.....	3				27	53	6
Sugarcane, stalks.....	347	1, 868	54	647	326	134	265
Sweet potatoes.....	41	176	100	58	709	2, 040	599

#### INSPECTION OF VESSELS

An effort is made to meet and board on arrival all vessels arriving from foreign ports. In the case of California and Florida, State service of this kind had been established, and these services have been taken over on a collaboratorship basis at a very trivial Federal cost—that is, being still supported as formerly by these States. Recently a similar arrangement has been effected with Mississippi. No other States have such general port-inspection service. The record of vessel inspection given in Table 5 is exclusive of the service in the three States mentioned. Such inspection includes a search of the state-rooms, ice boxes, fruit and vegetable lockers, crews' quarters, and passengers' quarters. All such work is performed in close cooperation with the representatives of the Customs Division, Treasury Department. In addition, inspectors of the board meet all vessels arriving

from Porto Rico and collaborators of the board likewise meet and inspect all vessels arriving at California ports from Hawaii for the purpose of preventing the entry of certain fruits and vegetables subject to domestic quarantine. This is entirely separate and additional to the inspection of strictly commercial shipments discussed under the title "Cargo inspection."

TABLE 5. —*Ships inspected during 1926 exclusive of Florida, Mississippi, and California ports*

Port	Number inspected	Number on which contraband was found
Astoria.....	137	28
Baltimore.....	627	305
Boston.....	1,062	620
Charleston.....	150	63
Galveston.....	506	229
Houston (3 months).....	30	3
Mobile.....	325	166
New Orleans.....	2,363	1,293
New York.....	4,451	2,653
Philadelphia.....	1,606	1,106
Portland, Oreg.....	405	205
Providence (2 months).....	14	4
Seattle.....	1,129	508

#### CARGO INSPECTION

The products subject to restriction now cover a wide range of articles which move in great volume, all of which are inspected as a condition of entry either at the port of custom's entry or at port of first arrival. These include large shipments of nursery stock, such as fruit and rose stocks, bulbs, tree seeds, huge quantities of fruits and vegetables, numerous consignments of cotton lint, cotton waste, broomcorn, paddy rice, etc. Information as to the volume of such material is given in Tables 10 to 25.

Table 6 following gives the number of consignments or shipments requiring inspection, and the results of such inspection in the interception of injurious insects and plant diseases.

TABLE 6.—*Inspections of shipments entered under permit fiscal year 1926*

Port	Commercial shipments under permit requiring inspection	Interceptions	Species of insects collected	Species of plant diseases collected
Baltimore.....	281	86	84	4
Boston.....	2,322	300	473	22
Charleston.....	88	3	3	-----
Chicago.....	133	-----	-----	-----
Galveston <sup>1</sup> .....	-----	-----	-----	-----
Houston <sup>1</sup> .....	106	3	10	-----
Mobile.....	193	4	4	-----
New Orleans.....	2,649	295	329	15
Norfolk.....	248	-----	-----	-----
New York.....	13,106	1,454	1,509	255
Philadelphia.....	1,265	210	583	43
Portland, Oreg.....	86	49	80	3
Seattle.....	700	132	169	13
St. Louis.....	80	12	12	2
Providence.....	17	3	4	-----
Total.....	21,274	2,551	3,260	357

<sup>1</sup> Up to April 30, commercial shipments arriving under permit at Houston were inspected by the inspector of the board stationed at Galveston. On May 1 an inspector was placed at Houston.

#### FOREIGN PARCEL-POST INSPECTION

In cooperation with customs and post office officials, foreign parcel-post packages have been inspected at several of the more important ports of entry. Arrangements have been effected with the departments referred to to refer to the inspectors of the board for examination all mail packages from foreign countries which upon examination or external evidence are found to contain plants or plant products. Such mail packages arriving at ports where there are no representatives of the board are dispatched to the nearest port at which inspectors are stationed. Table 7 indicates the number of foreign packages intercepted containing prohibited or restricted material.

TABLE 7.—*Foreign parcel-post inspection, 1926*

	Number of packages	Packages inspected and released	Packages fumigated and released	Packages refused entry	Packages containing infested or infected material	Species of insects collected	Species of plant diseases collected
Baltimore.....	30	1	5	24	9	5	4
Boston.....	2,542	1,497	790	255	89	96	16
Chicago.....	940	256	0	684	23	29	5
New Orleans.....	30	0	15	15	0	0	0
New York.....	4,182	3,460	548	174	13	15	1
Philadelphia.....	2,583	2,070	210	303	83	93	9
Portland, Oreg.....	137	98	16	23	0	0	0
St. Louis.....	402	245	47	110	10	14	1
Seattle.....	209	108	6	95	1	-----	1
Total.....	11,055	7,735	1,637	1,683	228	252	37

In addition 68,704 packages containing shamrock plants were inspected and released.



## DISTRICT OF COLUMBIA INSPECTION

This important feature of the board's work consists of the inspection, and when necessary the disinfection, of plants and plant products introduced by the Department of Agriculture, as well as all plants imported by private individuals in accordance with the provisions of regulation 14, quarantine 37, with the exception of a limited number which are inspected by collaborators at the port of San Francisco. In addition, all foreign plants imported under regu-

lations 3 and 14, of quarantine 37 and all domestic plants, Christmas trees, etc., entering the District of Columbia are examined by this force. Other products requiring examination include plants distributed from the U. S. Botanic Garden and those offered for interstate shipment by private individuals in the District of Columbia. Material offered for examination is frequently found to be infested or infected, necessitating fumigation or sterilization.

TABLE 8.—*Summary of plants and plant products offered for inspection in the District of Columbia, 1926*

Material inspected	Foreign	Domestic	Disinfected	Number infested with insects <sup>1</sup>	Number infected with diseases
Number of lots of plants or plant products (departmental).....	5, 557	7, 123	9, 097	819	79
Number of shipments of plants under regulation 14, quarantine 37 (commercial).....	1, 229	-----	210	168	174
Number of shipments of plants under regulations 3 and 15, quarantine 37 (commercial).....	529	-----	337	17	9
Number of containers of domestic plants (mail, express and freight).....	-----	8, 512	-----	-----	-----
Shipments of plants made by U. S. Botanic Garden.....	-----	5, 702	-----	-----	-----
Shipments of plants by private individuals.....	-----	148	14	11	-----
Interceptions of plants and plant products referred to Washington <sup>2</sup> .....	1, 017	-----	267	27	-----

<sup>1</sup> This indicates the number of lots or shipments found to be infested, and not the number of species of insects collected. Some shipments were found to contain a dozen or more species of insects.

<sup>2</sup> These interceptions represent plants and plant products arriving by mail, without permit.

## INSPECTION AND CERTIFICATION OF FRUITS AND VEGETABLES IN PORTO RICO FOR SHIPMENT TO THE MAINLAND

In order to meet the provisions of quarantine 58 (domestic), inspectors have been stationed in Porto Rico for the purpose of inspecting and certifying certain fruits and vegetables for shipment to the mainland. Offices have been established for this work in San Juan and Mayaguez. As a basis for the issuance of certificates, fruits and vegetables offered for shipment to the mainland are inspected in the field and later in the packing houses. During the period under review, in excess of 5,000 certificates were issued, representing approximately 2,000,000 boxes, crates, and barrels of fruits and vegetables. As time permits, the inspectors engaged in this work cooperate with officials of the Porto Rican Department of Agriculture and Labor in the inspection of foreign vessels arriving at San Juan and Mayaguez.

and certified prior to shipment. This work is performed for the most part by inspectors of the Federal Horticultural Board. Cooperative arrangements, however, have been made with officials

TABLE 9.—*Summary of plants and seeds examined for distribution from plant-propagating stations of the department, 1926*

	Plants	Packets of seeds	Budsticks and cuttings	Roots and tubers	Total
Bell, Md.....	41, 848	5	963	-----	42, 816
Chico, Calif.....	23, 880	157	5, 869	50	29, 956
Miami, Fla.....	250	2	325	-----	577
Bellingham, Wash.....	-----	-----	10	-----	10
Savannah, Ga.....	7, 404	-----	32	-----	7, 436
District of Columbia.....	4, 298	22, 520	5, 561	33, 783	66, 162
Chapman Field, Fla.....	2, 686	18	89	-----	2, 793
Mandan, N. Dak.....	161, 000	-----	-----	-----	161, 000
Total.....	241, 366	22, 702	12, 849	33, 833	310, 750

of the States of California and North Dakota for the purpose of examining

## INSPECTION OF PLANT INTRODUCTION GARDENS

All plants for distribution from the plant introduction gardens of this department are required to be inspected

and certifying plants for distribution from the gardens at Chico and Mandan. This arrangement effects quite a saving to the board in the matter of transportation. Table 9 indicates the number of plants, etc., inspected and certified prior to distribution from these gardens.

### RECORDS OF IMPORTS OF RESTRICTED PLANTS AND PLANT PRODUCTS

Under various foreign quarantines certain plants and plant products are restricted as to entry and made subject to inspection and, if necessary, disinfection, for the purpose of excluding various plant diseases and insect pests. Among these restricted plants and plant products are nursery stock, plants, and seeds for propagation, fruits and vegetables, grains from certain countries, broomcorn, and cotton, cotton waste, cotton wrappings, and cottonseed prod-

ucts. The records of the importations of these articles are indicated in the following discussion and tables.

### IMPORTATIONS OF NURSERY STOCK, PLANTS, AND SEEDS<sup>1</sup>

The importations recorded in Tables 10, 11, 12, and 13 are entered under regulation 3 of quarantine 37, under permits which are made continuing and unlimited as to the quantity which may be imported. The restrictions under this regulation are intended merely to afford opportunity to inspect, and, if necessary, safeguard the products as they are so entered. In the case of Table 10, the entries made in the preceding year are also listed for the purpose of comparison, and in Table 12 the bulb entries of the last seven years are brought together to show the fluctuation in the entry of different classes of bulbs.

TABLE 10.—*Importation of fruit, rose, and nut stocks, cuttings, and cions, under quarantine No. 37, year ended June 30, 1926*

[Figures indicate number of plants]

Kind of stocks, cuttings, and cions	Argentina	Bulgaria	Canada	Czechoslovakia	England	France	Germany	Holland	Ireland
Apple.....			2,072	21		4,301,800	513	356,000	
Cherry.....					12	6,104,800	200	36,500	
Grape.....	20	3,800	59			1,820	445		
Nectarine.....					42				
Peach.....					48				
Pear.....			95	9		3,776,600	1,000	40,000	
Plum.....				3		1,823,700	1,088	6,500	
Quince.....						862,200	200	21,000	
Rose.....					3,994,900	1,816,250	4,100	4,805,470	136,000
Nut.....						35,500	100		
Total.....	20	3,800	2,226	33	3,995,002	18,722,670	7,646	5,265,470	136,000

Kind of stocks, cuttings, and cions	Italy	Norway	Portugal	Scotland	Spain	Switzerland	Yugoslavia	Total	
								1925-26	1924-25
Apple.....	266,000	3						4,926,409	5,608,646
Cherry.....	170,000		4					6,311,516	8,532,655
Fig.....	7				3	12	11	33	200
Grape.....	3,702		111		24			9,981	2,905
Nectarine.....								42	
Peach.....								48	
Pear.....	40,000	3						3,857,707	3,321,635
Plum.....	72,529							1,903,820	2,271,314
Quince.....	6,000							889,400	963,650
Rose.....	28,200			60,000				10,844,920	8,298,524
Nut.....								35,600	34,786
Total.....	586,438	6	115	60,000	27	12	11	28,779,476	29,034,720

<sup>1</sup> Except as restricted by specific quarantines, field, vegetable, and flower seeds, and plant products imported solely for medicinal, food, or manufacturing purposes are not restricted as to entry, and the taking out of permits for such articles is not required. No record is therefore kept by the Federal Horticultural Board of the entry of such articles.

<sup>2</sup> Includes 405 olive cuttings.

TABLE 11.—*Importation of bulbs under Regulation 3 of Quarantine 37, year ended June 30, 1926*

[Figures indicate number of bulbs]

Bulbs	South Africa	Austria	Azores	Belgium	Bermuda	Canada	China	Denmark	England	France	Germany	Greece
Chionodoxa.....									976	10		
Crocus.....						13		15	9,467	150		40
Eranthis.....									371			
Fritillaria.....									250			30
Galanthus.....						12			1,737			134
Hyacinth.....	4	20				298		2	133	785, 115		23
Ixia.....	3								824			
Lily.....			8, 520		724, 580	22		2	10, 346	535, 098		12, 759
Lily of the Valley.....									548		19, 749, 783	
Muscari.....						4			2, 817			
Narcissus <sup>1</sup> .....	10					191 1, 608, 903		173	1, 142, 339 81, 365, 855		284	
Scilla.....	2					12			34, 420	30		40
Tulip.....	15	36		56		183		961	5, 304	62, 300		44
Total.....	34	56	8, 520	56	724, 580	735 1, 608, 903		1, 160	1, 209, 532 82, 748, 558		19, 763, 137	3

Bulbs	Holland	India	Ireland	Italy	Japan	Korea	Palestine	Philippine Islands	Portugal	Rumania	Scotland	Sweden	Wales	Total
Chionodoxa.....	838, 651													839, 637
Crocus.....	10, 889, 251		24								8			10, 898, 968
Eranthis.....	213, 802													214, 173
Fritillaria.....	209, 155			8								100		209, 543
Galanthus.....	1, 126, 425										20			1, 128, 335
Hyacinth.....	22, 896, 960			5										23, 682, 560
Ixia.....	544, 451													545, 278
Lily.....	204, 288	14	53	20, 107	14, 514, 363	6		913	7	4	2	6		16, 031, 090
Lily of the Valley.....	793, 430											24		20, 543, 785
Muscari.....	1, 401, 752													1, 404, 573
Narcissus <sup>1</sup> .....	58, 257, 582		617	586	6, 200					6	173	1, 280		142, 384, 199
Scilla.....	1, 978, 242			1										2, 012, 750
Tulip.....	106, 780, 458			95			11			39	22		48	106, 849, 572
Total.....	206, 134, 447	14	694	20, 802	14, 520, 563	6	11	913	7	49	225	30	1, 428	326, 744, 463

<sup>1</sup> Importations practically completed in fall of 1925, prior to restrictions beginning 1926.TABLE 12.—*Summary of bulb importations, Regulation 3, Quarantine 37, for the years 1919-20 to 1925-26*

Bulbs	1919-20	1920-21	1921-22	1922-23	1923-24	1924-25	1925-26
Chionodoxa <sup>1</sup> .....					339, 766	465, 422	839, 637
Crocus.....	3, 977, 892	5, 514, 805	6, 319, 082	8, 286, 500	10, 815, 920	10, 624, 670	10, 898, 968
Eranthis <sup>1</sup> .....					93, 314	152, 787	214, 173
Fritillaria <sup>1</sup> .....					92, 951	104, 483	209, 543
Galanthus <sup>1</sup> .....					797, 381	895, 003	1, 128, 335
Hyacinth.....	16, 375, 494	22, 568, 891	24, 808, 236	29, 142, 797	32, 197, 740	27, 947, 261	23, 682, 560
Ixia <sup>1</sup> .....					335, 158	371, 983	545, 278
Lily.....	14, 538, 936	22, 490, 533	8, 219, 460	9, 145, 630	9, 690, 486	11, 207, 559	16, 031, 090
Lily of the Valley.....	9, 964, 847	3, 606, 746	14, 951, 170	19, 603, 092	17, 568, 835	18, 980, 311	20, 543, 785
Muscari <sup>1</sup> .....					612, 329	906, 259	1, 404, 573
Narcissus.....	56, 032, 918	77, 956, 195	77, 270, 548	77, 193, 281	92, 659, 666	106, 314, 049	142, 384, 199
Scilla <sup>1</sup> .....					994, 762	1, 742, 514	2, 012, 750
Tulip.....	49, 972, 184	55, 075, 343	64, 846, 940	76, 719, 116	92, 539, 157	96, 290, 452	106, 849, 572
Unclassified.....	1, 653, 790	4, 756, 369	70, 750	183, 900			
Total.....	152, 516, 061	191, 968, 882	196, 486, 186	220, 274, 316	258, 737, 465	276, 002, 753	326, 744, 463

<sup>1</sup> Imported under special permit from June 1, 1919 to January 1, 1923.



TABLE 13.—*Importation of tree seeds under Quarantine No. 37, year ended June 30, 1926*<sup>1</sup>

[Figures indicate number of pounds]

Country of origin	Apple	Cherry	Fig	Mango	Musa	Nut and palm	Onion sets	Ornamental and tree	Perseimon	Prunus	Pyrus	Quince	Rose	Strawberry	Vitis	Total
Africa.....								4								4
Australia.....						7, 175		77								7, 252
Austria.....	10	2, 110				155	16	9, 533		1, 911	351	5				14, 091
Brazil.....						1, 750		4								1, 754
Canada.....								1, 379								1, 379
Canary Islands.....						30	120	2								152
Ceylon.....						750										750
Chile.....								463								463
China.....						115	5	4, 114	68	158	707					5, 167
Cuba.....						4, 179		32								4, 211
Czechoslovakia.....							41	2, 578			44					2, 622
Denmark.....								466								507
England.....						4, 500		46								4, 546
France.....	19, 329	3, 386	5			351		4, 725		297	616	6	7	2		28, 724
Germany.....								1, 414		9			16			1, 439
Greece.....								11								11
Holland.....		10						48								58
Hungary.....								17								17
India.....						36		46								82
Italy.....						16		1, 598		143						1, 757
Japan.....		75				1, 104		10, 638	104	472	4, 024	272	739		22	17, 450
Korea.....								10								10
Mexico.....				5	40			49								94
New Zealand.....								30								30
Persia.....												154				154
Poland.....								387		12						399
Russia.....								195								195
Scotland.....								288								288
Sweden.....								249								249
Switzerland.....							20									20
Trinidad, British West Indies.....						780										780
Yugoslavia.....							4, 480									4, 480
Total.....	19, 339	5, 581	5	5	40	20, 941	4, 682	38, 403	172	3, 002	5, 742	437	762	2	22	99, 135
1924-25.....	15, 173	5, 367				5, 690		41, 118	127	2, 245	4, 300	3, 087	241	5		140, 969

<sup>1</sup> About 400 packages of miscellaneous seeds, kinds and quantities not specified, were received by mail at the inspection house and after inspection forwarded to the consignees (not included in above table).<sup>2</sup> This total includes 63,613 pounds avocado seed and 3 pounds raspberry seed.TABLE 14.—*Distribution by States of bulbs, nursery stock, and seeds imported under Regulation 3 of Quarantine 37, year ended June 30, 1926*

State	Stocks, cuttings, and cions (number)				Seeds (pounds)					
	Bulbs (cases)	Fruit	Rose	Nut	Fruit	Nut and palm	Onion sets	Ornamental and tree	Rose	Total
Alabama.....	500	110, 000			81	16		359	10	466
Alaska.....	3									
Arizona.....	76							5		5
Arkansas.....	301	75, 000								
California.....	9, 512	809, 886	3, 500		375	317	5	1, 171		1, 868
Colorado.....	1, 022	1, 000	65, 500					10		10
Connecticut.....	5, 473	1, 899, 500	1, 464, 450		224	377		397	15	1, 013
Delaware.....	365	63, 000								
District of Columbia.....	1, 166	19			20	30		2		52
Florida.....	1, 488	12, 500	10, 000		35	5, 055		351		5, 441
Georgia.....	1, 190	69, 000			149	411		4, 432	79	5, 071
Idaho.....	102	3, 800								
Illinois.....	38, 400	139, 519	1, 740, 875		119	1, 266		4, 088	2	5, 475
Indiana.....	2, 411	477, 000	653, 650				41	1		42
Iowa.....	2, 341	3, 049, 300	373, 725	2, 000	2, 828	40		448	1	3, 317
Kansas.....	823	343, 000			12, 032			1, 127		13, 159

TABLE 14.—*Distribution by States of bulbs, nursery stock, and seeds imported under Regulation 3 of Quarantine 37, year ended June 30, 1926—Continued*

State	Stocks, cuttings, and cions (number)				Seeds (pounds)					
	Bulbs (cases)	Fruit	Rose	Nut	Fruit	Nut and palm	Onion sets	Orna- men- tal and tree	Rose	Total
Kentucky.....	1, 296		10, 000					2		2
Louisiana.....	630					11		24		35
Maine.....	579	10						55		55
Maryland.....	1, 810	339, 000	33, 900		100					100
Massachusetts.....	9, 231	7, 510	103, 600		28	112		736		876
Michigan.....	7, 331	592, 000	153, 200		6	5		141	4	156
Minnesota.....	2, 987		10, 000		11			456		467
Mississippi.....	312							3		3
Missouri.....	3, 267	375, 500			3, 307	7		55		3, 369
Montana.....	282									
Nebraska.....	780	20, 000						17		17
Nevada.....	3									
New Hampshire.....	339							363		363
New Jersey.....	11, 564	23, 500	1, 110, 509		64	7, 576		471	185	8, 296
New Mexico.....	60									
New York.....	86, 801	6, 938, 641	3, 220, 636	22, 500	2, 861	2, 718	4, 496	5, 624	237	15, 936
North Carolina.....	736	238, 000			1			893		894
North Dakota.....	201							16		16
Ohio.....	11, 791	703, 350	1, 372, 025	10, 000	63	279		612	50	1, 004
Oklahoma.....	544									
Oregon.....	2, 399	222, 000	10, 000		486	4		486	5	981
Pennsylvania.....	26, 822	761, 742	377, 750	1, 100	8, 522	2, 424		12, 413	131	23, 490
Rhode Island.....	1, 774	6, 000				5		89		94
South Carolina.....	257									
South Dakota.....	131		9, 000		6					6
Tennessee.....	1, 163	208, 000	28, 500					38		38
Texas.....	2, 388	244, 000	21, 000		1	134	120	1, 928		2, 183
Utah.....	353	108, 000	6, 000							
Vermont.....	369							100		100
Virginia.....	2, 362	59	10, 000			8	20	50	5	83
Washington.....	3, 354	59, 120	1, 000		3, 028	63		1, 233	38	4, 362
West Virginia.....	578									
Wisconsin.....	3, 645		38, 100			23		203		226
Wyoming.....	35							2		2
Exported by permittee.....	383		18, 000			60		2		62
Total.....	251, 530	17, 898, 956	10, 844, 920	35, 600	34, 347	20, 941	4, 682	38, 403	762	99, 135
1924-25.....	199, 522	20, 701, 410	8, 298, 524	34, 786	93, 920	5, 690		41, 118	241	140, 969

The record of entry under special permits issued under the provisions of regulation 14 of quarantine 37 for the purpose of keeping the country supplied with new varieties and necessary propagating stock and to meet other technical and educational needs is given in Table 15.

During the year, 1,445 such permits were issued, authorizing the entry of 80,982,954 plants and bulbs; a total of 6,021,508 plants and bulbs was imported under 1,200 of these permits. Upward of 70,000,000 of the plants authorized entry represented restricted bulbs for propagation, the entry of

which was not made until after the close of the fiscal year concerned in this report, and will therefore appear in the report for the following fiscal year. A summary of permits issued during the entire period of the quarantine to date is given in Table 16. The number of varieties considered has now reached a total of 32,292, of which 30,465 have been approved for entry. In addition to the tables mentioned, there has been prepared a table (Table 18) showing the distribution of the imported special-permit material by States.

TABLE 15.—*Special-permit importations, 1926, with combined totals for the period 1920-1926*

Class of plants	Fiscal year 1926				Totals, 1920-1926			
	Permits issued		Permits imported		Permits issued		Permits imported	
	Num- ber	Quantity	Num- ber	Quantity	Num- ber	Quantity	Num- ber	Quantity
Gladioli.....	152	2, 441, 142	136	1, 880, 054	921	39, 766, 834	723	25, 598, 298
Dahlias.....	48	2, 845	42	2, 216	390	32, 460	311	21, 213
Iris, rhizomatous.....	155	55, 481	165	21, 797	844	218, 129	714	109, 985
Iris, bulbous.....	164	5, 290, 729	161	2, 453, 408	754	26, 536, 763	566	16, 898, 011
Other bulbs, rhizomes, and roots.....	217	1, 913, 860	193	948, 883	826	9, 560, 159	602	4, 583, 225
Peonies.....	121	127, 972	111	108, 743	737	1, 245, 927	567	583, 380
Roses.....	168	36, 369	154	28, 556	675	151, 446	577	110, 997
Orchids.....	163	27, 584	146	20, 372	750	131, 679	636	95, 140
Ornamentals.....	240	199, 302	213	169, 891	862	2, 752, 491	668	1, 726, 075
Herbaceous plants.....	160	417, 853	147	386, 462	784	4, 476, 733	603	2, 747, 850
Fruit trees and small fruits.....	36	1, 414	26	1, 126	77	7, 523	43	2, 030
Narcissi.....	156	70, 468, 403	0	0	156	70, 468, 403	0	0
Total.....		80, 982, 954		6, 021, 508		155, 348, 547		52, 476, 204

TABLE 16.—*Special-permit importations, yearly totals, 1920-1926*

Fiscal year	Permits issued		Permits imported	
	Number	Quantity	Number	Quantity
1920.....	311	10, 752, 844	171	3, 484, 195
1921.....	622	13, 965, 013	411	8, 132, 634
1922.....	750	9, 573, 199	518	3, 344, 026
1923.....	897	15, 175, 003	719	10, 357, 406
1924.....	1, 107	15, 381, 621	862	12, 561, 306
1925.....	1, 235	9, 517, 913	1, 087	8, 575, 129
1926.....	1, 445	80, 982, 954	1, 200	6, 021, 508
Total.....	6, 367	155, 348, 547	4, 968	52, 476, 204

TABLE 17.—*Special-permit material: Number of different varieties of plants requested and approved for fiscal years 1920-1926*

Class of plants	Requested	Approved	Percentage approved
Gladioli.....	1, 152	1, 034	89. 76—
Dahlias.....	2, 437	2, 316	95. 03+
Iris, rhizomatous.....	1, 999	1, 888	94. 45—
Iris, bulbous.....	420	419	99. 76+
Other bulbs, rhizomes, and roots.....	2, 183	2, 147	98. 35+
Peonies.....	1, 686	1, 453	86. 18+
Roses.....	2, 984	2, 663	89. 24+
Orchids.....	6, 340	6, 302	99. 40+
Ornamentals.....	8, 243	7, 568	91. 81+
Herbaceous plants.....	4, 153	3, 993	96. 15+
Small fruits and fruit trees.....	205	192	93. 66+
Narcissi.....	490	490	100. 00
Total.....	32, 292	30, 465	94. 34



TABLE 18.—*Distribution of special-permit material by States for fiscal years 1920-1926*

State	Gladioli	Dahl-ias	Rhi-zoma-tous iris	Bulbous iris	Peonies	Roses	Orchids	Orna-ments, etc.	Totals
Alabama.....	14,985	0	0	15,980	0	174	0	0	31,139
Arizona.....	4	14	0	0	0	0	14	2,174	2,206
Arkansas.....	0	0	0	18,000	0	0	0	0	18,000
California.....	1,782,600	3,754	23,806	9,327,415	2,158	19,445	27,410	1,577,879	12,764,467
Colorado.....	15,755	0	0	27,990	0	0	1,038	5,170	49,953
Connecticut.....	10,791	624	837	22,745	104	31,240	6	132,170	198,517
Delaware.....	0	0	22	700	16	0	64	5,195	5,997
District of Columbia.....	500	108	59	127	0	213	74	226	1,307
Florida.....	47,510	0	0	331,370	0	21	0	277,081	655,982
Georgia.....	5,000	12	0	100,710	0	0	0	2,910	108,632
Idaho.....	39	0	0	2,000	0	0	0	0	2,039
Illinois.....	3,205,804	85	11,811	841,390	39,518	9,691	495	215,193	4,323,987
Indiana.....	2,365,273	186	1,859	502,398	3,645	2,169	135	29,378	2,905,043
Iowa.....	77,859	0	0	10,000	23,057	0	0	13,946	124,862
Kansas.....	0	5	1,583	0	1,096	0	0	373	3,057
Kentucky.....	0	267	0	51,200	0	0	415	0	51,882
Louisiana.....	2,500	116	0	21,750	0	0	766	250	25,382
Maine.....	350	0	13	0	262	0	0	446	1,071
Maryland.....	23,057	302	128	101,000	18,389	500	254	8,524	152,154
Massachusetts.....	3,433,304	742	3,064	480,560	6,216	1,854	13,342	406,724	4,345,806
Michigan.....	11,650,051	2,519	2,925	495,822	72,307	290	86	456,858	12,680,858
Minnesota.....	81,231	44	964	0	7,406	160	366	34,860	125,031
Mississippi.....	6,500	0	9	49,776	0	0	0	27	56,312
Missouri.....	2,450	99	292	86,711	991	0	3,440	19,396	113,379
Montana.....	0	0	0	0	0	0	0	100	100
Nebraska.....	0	276	0	0	14	0	0	351	641
Nevada.....	0	0	0	0	0	0	0	0	0
New Hampshire.....	40,021	7	0	11,500	0	0	0	1,183	52,711
New Jersey.....	97,450	3,788	9,931	834,216	38,364	28,940	21,124	2,275,702	3,309,518
New Mexico.....	0	0	0	0	0	0	0	0	0
New York.....	1,768,838	2,516	27,215	1,166,289	182,544	4,272	17,312	2,406,746	5,575,732
North Carolina.....	3,975	82	0	116,990	0	0	0	24	121,071
North Dakota.....	0	0	0	0	7	0	0	0	7
Ohio.....	473,488	1,659	16,457	40,940	117,749	3,986	127	738,492	1,392,898
Oklahoma.....	510	0	0	14,000	0	0	0	198	14,708
Oregon.....	38,964	1,012	1,408	220,533	2,650	1,140	0	35,473	301,180
Pennsylvania.....	352,785	1,365	2,454	152,393	50,354	3,653	7,495	241,329	811,828
Rhode Island.....	710	1,053	1,557	86,190	5,209	313	157	25,251	120,440
South Carolina.....	0	0	0	30,000	0	0	0	0	30,000
South Dakota.....	460	0	11	0	2,426	1,527	0	536	4,960
Tennessee.....	0	202	361	151,653	222	0	0	3,400	155,838
Texas.....	2,000	1	50	653,031	0	290	6	28,451	683,829
Utah.....	0	0	0	11,500	0	0	0	4,747	16,247
Vermont.....	3,984	0	36	8,010	2,245	0	0	1,467	15,742
Virginia.....	16,000	0	2	528,604	1,196	0	0	41,266	587,068
Washington.....	20,142	319	2,686	272,565	3,453	624	0	19,332	319,121
West Virginia.....	0	0	0	4,000	0	0	0	36	4,036
Wisconsin.....	53,408	56	445	107,950	1,782	495	1,014	46,316	211,466
Wyoming.....	0	0	0	0	0	0	0	0	0
Total.....	25,598,298	21,213	109,985	16,898,011	583,380	110,997	95,140	9,059,180	52,476,204

In addition to the foregoing, there were imported from Canada, under regulation 15, quarantine 37, 128,336 bulbs, plants, trees, or cuttings.

#### IMPORTATIONS OF COTTON AND COTTON PRODUCTS

Tables 19 to 22 indicate, respectively, the importations of cotton, cotton waste, bagging, cottonseed, seed cotton, and cottonseed products during the year. The actual number of bales of

cotton, cotton waste, and bagging is indicated, but inasmuch as bales vary in size, they are referred to as running bales.

In addition to the commercial importations indicated below, the board supervised the entry and disinfection of 877 cotton samples imported by freight or express, 55 cotton waste samples imported by freight or express, and 17,852 cotton and cotton waste samples imported by parcel post.

TABLE 19.—*Importation of ginned cotton, by country of growth and port of entry, 1925-26*

[Running bales]

Country	Black Rock	Boston	Buffalo	Calxico	El Paso	Fabens	Galveston	Houston	Island Pond	Malone	Newport	New York
Argentina.....												1
British West Indies.....												865
China.....		3,385										4,696
Dominican Republic.....												174
Dutch East Indies.....		814										1,115
Dutch Guiana.....												147
Ecuador.....		18										167
Egypt.....		141,627										21,100
Haiti.....												1,121
India.....		12,352										13,805
Mexico.....				78,535	1,104	3,544						6,162
Paraguay.....												25
Peru.....		2,430										82,061
Porto Rico.....												2,417
Uganda.....		10										
United States.....	44	4,026	176				127	88	27	89	869	705
Venezuela.....												132
Unknown.....		144										
Total.....	44	164,806	176	78,535	1,104	3,544	127	88	27	89	869	134,693

Country	Niagara Falls	Norfolk	Nyando	Philadelphia	Portland	Richford	Rouses Point	St. Albans	San Francisco	Seattle	Vanceboro	Yuma	Total
Argentina.....													1
British West Indies.....													865
China.....					573				10,771	3,579			23,004
Dominican Republic.....													174
Dutch East Indies.....													1,929
Dutch Guiana.....													147
Ecuador.....													185
Egypt.....													162,727
Haiti.....													1,121
India.....					250				1,025	100			27,532
Mexico.....									567			24	189,936
Paraguay.....													25
Peru.....													84,491
Porto Rico.....													2,417
Uganda.....													10
United States.....	235	210	176	63		2	57	1,489			566		8,949
Venezuela.....													132
Unknown.....													144
Total.....	235	210	176	63	823	2	57	1,489	12,363	3,679	566	24	<sup>2</sup> 403,789

<sup>1</sup> Includes unginned cotton from the Imperial Valley, Lower California, Mexico, in the equivalent of 24 bales of 500 pounds each.

<sup>2</sup> Includes 1,336 bales of linters.

TABLE 20.—*Importation of cotton waste, by country of origin and port of entry, 1925-26*

[Running bales]

Country	Balti- more	Boston	Charles- ton	Detroit	Galves- ton	New Or- leans	New- port	New York	Niag- ara Falls	Nor- folk
Belgium.....		359				99		717		
Brazil.....		28								
Canada.....		3,235		50			665	7	16	
Ceylon.....								52		
Chile.....								1		
China.....		151						1		
England.....	78	3,695	1,222			850		2,042		1,075
France.....		386	40			4		1,622		
Germany.....		651			45	4		2,171		
Holland.....		2,162						665		
India.....		211						6,712		
Italy.....		262						2,451		
Japan.....		100						801		
Mexico.....								1,030		
Scotland.....								78		
Spain.....								98		
Switzerland.....		2,988						1,011		
United States.....			3	38						
Total.....	78	14,228	1,265	88	45	957	665	19,459	16	1,075

Country	Phila- del- phia	Port Huron	Port- land	Rouses Point	St. Albans	San Fran- cisco	Savan- nah	Seattle	Total
Belgium.....	686								1,861
Brazil.....									28
Canada.....		26		79	37				4,115
Ceylon.....	298								350
Chile.....									1
China.....	18					294		205	669
England.....	3,525						53		12,540
France.....	792								2,844
Germany.....	2,452								5,323
Holland.....	1,348								4,175
India.....	3,506								10,429
Italy.....	2,637								5,350
Japan.....	395		55			4,423		6,027	11,801
Mexico.....									1,030
Scotland.....									78
Spain.....	137								235
Switzerland.....	886								4,885
United States.....									41
Total.....	16,680	26	55	79	37	4,717	53	6,232	65,755



TABLE 21.—*Importation of bagging, by country of origin and port of entry, 1925-26*

[Running bales]

Country	Baltimore	Boston	Buffalo	Charleston	Detroit	Galveston	Houston	New Orleans	New York	Norfolk	Philadelphia	Port Huron	San Francisco	Savannah	Total
Algeria.....											238				238
Argentina.....									100						100
Australia.....													15		15
Austria.....								1,025	704	380				421	2,530
Belgium.....	3,046	2,521	1	1,258				3,231	7,392	4,199	995		568	838	24,048
Canada.....		259			4,267				1,825	240	360	2,151			9,103
China.....															4
Cuba.....								517	407				4		924
Denmark.....								6,084	23,710	500					30,294
Egypt.....									994						994
England.....	2,128	4,172		1,654		293	5,211	13,803	9,459	13,685	5,599		2,886		58,890
France.....	1,027	461		883			1	5,577	10,572	1,627	2,542			361	23,051
Germany.....	3,116	2,278		1,330			31	10,118	20,723	2,723	1,706		469	1,219	43,713
Holland.....	716	3,032		1,791				8,380	9,009	7,017	1,721			1,057	32,723
Hungary.....											291				291
India.....									296		1,183				1,479
Ireland.....									850		32				882
Italy.....						2,278	3,418		8,955		878				15,529
Japan.....													537		537
Latvia.....		1							843		216				1,060
Lithuania.....									33						33
Malta.....									15						15
Norway.....		57							988						1,045
Philippine Islands.....									59						59
Scotland.....	683	2,756					602	198	4,073	161	1,850				10,323
Spain.....								726	4,964		265				5,955
Sweden.....		1,048						957	1,054		56				3,115
Switzerland.....		1,360		902					1,260	3,135	94				6,751
Turkey.....									287						287
Wales.....	42								261		57				360
Unknown.....											1				1
Total.....	10,758	17,945	1	7,818	4,267	293	8,123	54,034	108,833	33,667	18,084	2,151	1,593	6,782	274,349

TABLE 22.—*Importation of cottonseed, seed cotton, and cottonseed products, 1925-26*

[Tons]

Port	Cotton-seed	Seed cotton	Cotton-seed cake	Cotton-seed meal
Boston.....			3	51
Calxico.....	1 43,293			
Nogales.....				291
Yuma.....		1 18		
Total.....	43,293	18	3	342

<sup>1</sup> Entry of cottonseed and seed cotton grown in the Imperial Valley, Lower California, Mexico, is allowed under permit.

## IMPORTATIONS OF FRUITS AND VEGETABLES

Tables 23 and 24 indicate, respectively, the fruits and vegetables imported during the fiscal year by countries of origin and by ports of entry.

TABLE 23.—*Fruits and vegetables imported, year ended June 30, 1926, by countries of origin*

[Quarantine 56 unless otherwise designated]

Kind	Country and quantity	Total
Apricot.....pounds..	Argentina, 8,500; Chile, 130.....	8,630
Artichoke.....do.....	Chile, 23,614.....	23,614
Asparagus.....do.....	Argentina, 43,487; Chile, 2,148.....	45,635
Avocado.....do.....	Colombia (Santa Marta district), 13,750; Cuba, 4,945,709; Dominica, British West Indies, 1,670; Dominican Republic, 12; Mexico (seeds removed), 56,635.....	5,017,776
Ayale (Crescentia sp.), pounds.	Mexico, 400.....	400
Banana.....bunches..	Canal Zone, 641,738; Colombia, 2,917,269; Costa Rica, 5,391,130; Cuba, 3,195,675; Dominica, British West Indies, 1; Dominican Republic, 69; Grenada, British West Indies, 640; Guatemala, 5,848,328; Honduras, 15,322,665; British Honduras, 280,800; Jamaica, 14,645,310; Mexico, 3,590,600; Nicaragua, 3,082,947; Panama, 3,948,829; St. Lucia, British West Indies, 5,930.....	58,871,931
Bean (green):		
Faba.....pounds..	Chile, 11,203; Mexico, 56.....	11,259
Lima.....do.....	Cuba, 1,229,412; Mexico, 2,575.....	1,231,987
String.....do.....	Cuba, 90,148; Mexico, 413,096.....	503,244
Beet.....do.....	Bermuda, 739,389; Mexico, 257,457.....	996,846
Berry (Rubus).....do.....	Mexico, 972.....	972
Burdock.....do.....	Japan, 1,695.....	1,695
Cabbage.....do.....	Bermuda, 1,875; Cuba, 523,720; Denmark, 2,572,575; Holland, 11,566,380; Mexico, 34,127.....	14,698,677
Cacao bean pod.....do.....	Trinidad, British West Indies, 380; Venezuela, 300.....	680
Carrot.....do.....	Bermuda, 2,285,079; Mexico, 383,212.....	2,668,291
Cassava.....do.....	China, 300; Cuba, 306,648; Dominican Republic, 1,788.....	308,736
Cauliflower.....do.....	Cuba, 540; Holland, 31,710; Mexico, 11,307.....	43,557
Celery.....do.....	Bermuda, 2,270,056; Denmark, 10; Mexico, 1,373.....	2,271,439
Chayote.....do.....	Cuba, 25,615; Dominican Republic, 3,768; Mexico, 1,845.....	31,228
Cherry:		
Fresh.....do.....	Chile, 23,438.....	23,438
Dried (sour).....do.....	Austria, 16,550; Czechoslovakia, 27,913; Italy, 940,883; Yugoslavia, 258,444.....	1,243,790
Cipollino.....do.....	Italy, 1,903,609.....	1,903,609
Citrus medica.....packages..	Greece, 17; Italy, 10; Palestine, 3,521.....	3,548
Cloudberry.....pounds..	Norway, 1,113.....	1,113
Clover tops.....do.....	Mexico, 372.....	372
Crosnes.....do.....	Belgium, 7,070.....	7,070
Cucumber.....do.....	Bermuda, 9,630; Cuba, 460,569; England, 11; Mexico, 200,187; Virgin Islands, 68.....	670,465
Custard apple.....do.....	Chile, 200.....	200
Dasheen (includes colocasia, caladium, inhame, malanga, and taro), pounds.	Azores, 313,591; China, 532,929; Cuba, 128,373; Dominican Republic, 776,762; Japan, 427,574; Mexico, 603; Panama, 875.....	2,180,707
Date.....pounds..	Tunis, 2,205.....	2,205
Eggplant.....do.....	Chile, 40; Cuba, 4,708,295; Haiti, 50; Mexico, 469,342; Virgin Islands, 590.....	5,178,317
Endive.....do.....	Belgium, 1,535,727; England, 9,952; France, 6,400.....	1,552,079
Fennel.....do.....	Bermuda, 2,676.....	2,676
Garbanzo.....do.....	Mexico, 15.....	15
Garlic.....do.....	Azores, 100; Chile, 221,755; Egypt, 14,000; France, 132; Italy, 596,890; Madeira Islands, 5; Mexico, 623,935; Spain, 40,933.....	1,497,750
Ginger (crude).....do.....	China, 384,406; Cuba, 848; Dominican Republic, 1,545; Jamaica, 1,475; Japan, 4,631.....	392,905
Grapefruit.....do.....	Bahamas, 10,260; Cuba, 14,453,125; Dominica, British West Indies, 4,200; Jamaica, 19,520.....	14,487,105
Grape:		
Fresh (not hothouse), pounds.	Argentina, 2,150,700; Chile, 458,274; Mexico, 5,935.....	2,614,909
Hothouse.....pounds..	Belgium, 349,123; England, 3,400; France, 375.....	352,898
Processed.....do.....	Italy, 5,793,649.....	5,793,649
Waste.....do.....	Italy, 7,163.....	7,163
Horse-radish.....do.....	Czechoslovakia, 27,518; Denmark, 50; Germany, 2,029,029; Sweden, 500.....	2,057,097
Husk tomato.....do.....	Mexico, 35,743.....	35,743
Kale.....do.....	Bermuda, 678,140.....	678,140
Kohl-rabi.....do.....	Bermuda, 331; Mexico, 74.....	405
Kudzu.....do.....	China, 116,236.....	116,236
Lemon.....crates.....	Algeria, 100; Italy, 1,307,201; Jamaica, 19; Mexico, 14; Spain, 4,071.....	1,311,405
Lettuce.....pounds..	Bermuda, 67,481; Mexico, 1,115,819.....	1,183,300
Lily bulb (edible).....do.....	China, 13,807; Japan, 300.....	14,107
Lime (sour).....do.....	Antigua, British West Indies, 1,950; Canal Zone, 85; Costa Rica, 4,280; Dominica, British West Indies, 3,295,931; Dominican Republic, 561; Italy, 12; Jamaica, 234,758; Mexico, 1,268,993; St. Kitts, British West Indies, 1,500; St. Lucia, British West Indies, 102,290.....	4,910,360
Mangosteen.....pieces..	Guatemala, 38.....	38

TABLE 23.—*Fruits and vegetables imported, year ended June 30, 1926, by countries of origin—Continued*

Kind	Country and quantity	Total
Melon.....pounds.	Argentina, 977,554; Chile, 379,368; France, 150; Italy, 148,408; Mexico, 5,991,397; Spain, 131,674.	7,628,551
Mint.....do.	Bermuda, 2,988; Mexico, 439.....	3,427
Mustard.....do.	Bermuda, 765; Mexico, 25,019.....	25,784
Nectarine.....do.	Belgium, 289; Chile, 2,060.....	2,349
Okra <sup>1</sup> .....do.	Cuba, 892,398; Mexico, 36,306.....	928,704
Onion.....do.	Antigua, British West Indies, 3,800; Argentina, 418,232; Australia, 142,871; Azores, 135; Bermuda, 536,743; Chile, 1,302,631; Cuba, 58,800; Dominica, British West Indies, 2,600; Egypt, 32,801,377; France, 4,488; Greece, 50; Holland, 108,133; Hungary, 128,608; Italy, 1,484,335; Mexico, 1,510,236; Montserrat, British West Indies, 28,120; Spain, 82,713,375; Virgin Islands, 32,080.	121,276,614
Orange:		
Under quarantine 56, pounds.	Cuba, 120,862; Dominica, British West Indies, 140; Jamaica, 29,020.	150,022
Mandarin (quarantine 28), bundles.	Japan, 50,750.....	50,750
Pachyrhizus.....pounds.	China, 39,275.....	39,275
Parsley.....do.	Bermuda, 1,492,525; Mexico, 22,082.....	1,514,607
Parsnip.....do.	Bermuda, 740; Holland, 105,176; Mexico, 158.....	106,074
Partridge berry.....do.	Newfoundland, 2,050.....	2,050
Peach.....do.	Argentina, 80,066; Belgium, 1,654; Chile, 22,975.....	104,695
Pear.....do.	Argentina, 2,675; Chile, 700.....	3,375
Pea.....do.	Bermuda, 44; Chile, 4,151; Cuba, 310; Mexico, 9,090,141.....	9,094,646
Pepper.....do.	Bahamas, 195; Chile, 7,368; Cuba, 12,032,227; Dominican Republic, 425; Mexico, 5,349,951; Virgin Islands, 948.	17,391,114
Pigweed.....do.	Mexico, 228.....	228
Pineapple.....crates.	Azores, 11; Bahamas, 200; Brazil, 4; Costa Rica, 47,687; Cuba, 1,965,976; Dominica, British West Indies, 1; Dominican Republic, 3; Honduras, 1,385; Mexico, 34; Panama, 70.	2,015,371
Plantain.....bunches.	Canal Zone, 279; Costa Rica, 3; Cuba, 284,165; Dominican Republic, 10,490; Honduras, 129,439; British Honduras, 61,395; Mexico, 1,579; Panama, 8,217; St. Lucia, British West Indies, 8.	495,575
Plum.....pounds.	Argentina, 10,822; Chile, 6,598.....	17,420
Potato:		
Under quarantine 56, pounds.	Bermuda, 6,179,460.....	6,179,460
Under potato regulations (order of Dec. 22, 1913), pounds.	Cuba, 2,151,287; Mexico, 2,171,538.....	4,322,825
Prickly pear.....pounds.	Mexico, 3,960.....	3,960
Pumpkin.....do.	Cuba, 42,882; Dominican Republic, 113,684; Mexico, 19,616.....	176,182
Purslane.....do.	Mexico, 639.....	639
Radish.....do.	Bermuda, 204; Mexico, 33,360.....	33,564
Roselle.....do.	Mexico, 440.....	440
Salsify.....do.	Bermuda, 200.....	200
Sea onion.....do.	Denmark, 1,100.....	1,100
Sorrel.....do.	Bermuda, 392.....	392
Spinach.....do.	Mexico, 96,857.....	96,857
Squash.....do.	Bermuda, 240; Cuba, 460,289; Mexico, 73,789.....	534,318
Strawberry.....do.	Mexico, 1,185.....	1,185
Swiss chard.....do.	Bermuda, 1,085.....	1,085
Tamarind bean pod.....do.	Antigua, British West Indies, 26,619; Barbados, British West Indies, 150; Dominica, British West Indies, 4,938; Mexico, 98; St. Kitts, British West Indies, 423.	32,228
Tangerine.....do.	Argentina, 23,049.....	23,049
Thyme.....do.	Bermuda, 24; Dominican Republic, 22.....	46
Tomato.....do.	Argentina, 1,970; Bahamas, 4,932,821; Chile, 10,990; Cuba, 13,579,664; Dominica, British West Indies, 150; England, 47,066; Haiti, 964; Jamaica, 480; Mexico, 65,084,616; Virgin Islands, 194.	83,658,915
Turnip.....do.	Bermuda, 39,876; Mexico, 144,862.....	184,738
Udo.....do.	China, 650.....	650
Vaccinium (cranberry, etc.), pounds.	Finland, 3,750; Norway, 12,253; Sweden, 4,455.....	20,458
Water chestnut.....pounds.	China, 1,066,427.....	1,066,427
Water cress.....do.	Mexico, 2,570.....	2,570
Water-lily root.....do.	China, 89,322; Cuba, 1,024.....	90,346
Watermelon.....do.	Chile, 3,900; Cuba, 117,312; Dominica, British West Indies, 5; Mexico, 640,876.	762,093

<sup>1</sup> Prohibited importation from Mexico after June 24, 1926, at all border ports from El Paso east.



TABLE 24.—*Fruits and vegetables imported during year ended June 30, 1926, by ports of entry*

[Quarantine 56 unless otherwise designated]

Kind	Port and quantity	Total
Apricot.....pounds..	New York, 8,630	8,630
Artichoke.....do.....	New York, 23,614	23,614
Asparagus.....do.....	New York, 45,635	45,635
Avocado.....do.....	Eagle Pass (seeds removed), 1,389; El Paso (seeds removed), 1,814; Key West, 1,078,924; Laredo (seeds removed), 53,432; New Orleans, 1,757,364; New York, 729,868; Tampa, 1,394,985.	5,017,776
Ayale (Crescentia sp.), pounds.	Nogales, 400	400
Banana.....bunches..	Baltimore, 3,399,326; Boston, 3,907,088; Eagle Pass, 191; El Paso, 8,771; Galveston, 833,500; Jacksonville, 32,650; Key West, 47,032; Laredo, 108; Los Angeles, 451,649; Miami, 264,813; Mobile, 3,265,070; New Orleans, 22,861,211; New York, 17,653,746; Nogales, 30,595; Pensacola, 55,582; Philadelphia, 5,648,534; San Francisco, 53,719; Seattle, 500; Tampa, 357,846.	58,871,931
Bean (green):		
Faba.....pounds..	New York, 11,203; Nogales, 56	11,259
Lima.....do.....	New York, 1,229,412; Nogales, 2,575	1,231,987
String.....do.....	Brownsville, 346,454; Douglas, 3,120; Eagle Pass, 174; El Paso, 32,158; Laredo, 7,475; New York, 90,148; Nogales, 20,425; Tia Juana, 3,290.	503,244
Beet.....do.....	Calexico, 915; Douglas, 9,186; Eagle Pass, 808; El Paso, 231,394; New York, 739,389; Nogales, 15,154.	996,846
Berry (rubus).....do.....	Laredo, 972	972
Burdock.....do.....	Seattle, 1,695	1,695
Cabbage.....do.....	Calexico, 662; Douglas, 6,899; Eagle Pass, 41; Key West, 405,790; Laredo, 3,655; New Orleans, 28,845; New York, 14,227,965; Nogales, 22,870; Tampa, 1,950.	14,698,677
Cacao bean, pod.....do.....	New York, 680	680
Carrot.....do.....	Calexico, 2,224; Douglas, 11,818; Eagle Pass, 736; El Paso, 347,699; New York, 2,285,079; Nogales, 20,735.	2,668,291
Cassava.....do.....	Chicago, 300; Key West, 53,815; New York, 209,336; Tampa, 45,285.	308,736
Cauliflower.....do.....	Douglas, 1,957; New York, 32,250; Nogales, 9,350	43,557
Celery.....do.....	Douglas, 1,178; New York, 2,270,056; Nogales, 195; Philadelphia, 10.	2,271,439
Chayote.....do.....	El Paso, 1,525; Key West, 1,040; Laredo, 320; New Orleans, 20,735; New York, 6,398; Tampa, 1,210.	31,228
Cherry:		
Fresh.....do.....	New York, 23,438	23,438
Dried (sour).....do.....	Boston, 121,232; New York, 973,435; Philadelphia, 149,123	1,243,790
Cipollino.....do.....	Boston, 156,532; New York, 1,747,077	1,903,609
Citrus medica.....packages..	Jacksonville, 1; New York, 3,362; Philadelphia, 170; Portland, 2; St. Louis, 10; Seattle, 1; Washington, D. C., 2.	3,548
Cloudberry.....pounds..	Los Angeles, 1,003; New York, 110	1,113
Clover tops.....do.....	Douglas, 372	372
Crosnes.....do.....	New York, 7,070	7,070
Cucumber.....do.....	Brownsville, 300; Calexico, 1,346; Douglas, 1,302; El Paso, 210; Key West, 4,028; Laredo, 32; New Orleans, 1,890; New York, 459,915; Nogales, 196,997; Tampa, 4,445.	670,465
Custard apple.....do.....	New York, 200	200
Dasheen (includes colocasia, caladium, inhame, malanga, and taro), pounds.	Boston, 8,000; Calexico, 603; Chicago, 2,100; Key West, 47,789; Los Angeles, 44,625; New York, 841,303; Portland, 8,000; Providence, 313,591; San Francisco, 600,935; Seattle, 240,258; Tacoma, 2,000; Tampa, 71,503.	2,180,707
Date.....pounds..	New York, 2,205	2,205
Eggplant.....do.....	Calexico, 95; Douglas, 1,196; Key West, 39,205; Los Angeles, 29,182; New Orleans, 867,401; New York, 3,794,704; Nogales, 422,448; San Francisco, 16,421; Tampa, 7,665.	5,178,317
Endive.....do.....	New York, 1,552,079	1,552,079
Fennel.....do.....	New York, 2,676	2,676
Garbanzo.....do.....	Nogales, 15	15
Garlic.....do.....	Boston, 12,850; Calexico, 40; Douglas, 3,064; Eagle Pass, 424; El Paso, 60,385; Laredo, 378,735; Los Angeles, 350; New Orleans, 150,572; New York, 886,399; Nogales, 4,823; Providence, 108.	1,497,750
Ginger (crude).....do.....	Boston, 6,760; Chicago, 500; Los Angeles, 6,100; New York, 39,552; San Francisco, 264,909; Seattle, 73,084; Tacoma, 2,000.	392,905
Grapefruit.....do.....	Boston, 336,000; Chicago, 2,333,624; Cincinnati, 1,185,730; New York, 8,705,301; Philadelphia, 560; St. Louis, 1,925,890.	14,487,105
Grape:		
Fresh (not hothouse), pounds.	Eagle Pass, 429; El Paso, 5,110; Laredo, 151; New York, 2,608,974; Nogales, 245.	2,614,909
Hothouse.....pounds..	New York, 352,898	352,898
Processed.....do.....	Boston, 465,374; New York, 5,328,275	5,793,649
Waste.....do.....	New York, 7,163	7,163
Horse-radish.....do.....	New York, 1,874,959; Philadelphia, 181,466; San Francisco, 672.	2,057,097
Husk tomato.....do.....	Brownsville, 110; El Paso, 35,633	35,743
Kale.....do.....	New York, 678,140	678,140
Kohl-rabi.....do.....	Douglas, 48; Eagle Pass, 7; New York, 331; Nogales, 19	405
Kudzu.....do.....	Boston, 1,870; Los Angeles, 4,800; New York, 11,000; San Francisco, 73,061; Seattle, 24,065; Tacoma, 900.	116,236

TABLE 24.—*Fruits and vegetables imported during year ended June 30, 1926, by ports of entry—Continued*

Kind	Port and quantity	Total
Lemon.....crates..	Boston, 36,173; New Orleans, 245,841; New York, 1,029,266; Nogales, 14; Philadelphia, 111	1,311,405
Lettuce.....pounds..	Douglas, 11,532; Eagle Pass, 1,575; El Paso, 36,866; New York, 67,481; Nogales, 1,065,846	1,183,300
Lily bulb (edible)....do....	Boston, 1,589; Chicago, 560; San Francisco, 6,790; Seattle, 4,868; Portland, 300	14,107
Lime (sour).....do....	Boston, 5,611; Del Rio, 45; Eagle Pass, 10,534; El Paso, 24,893; Laredo, 1,057,667; Los Angeles, 158,538; New Orleans, 147,562; New York, 3,488,182; Nogales, 8,764; Providence, 12; San Francisco, 8,552	4,910,360
Mangosteen.....pieces..	New Orleans, 38	38
Melon.....pounds..	Boston, 7,000; Douglas, 488; El Paso, 984; New York, 1,630,142; Nogales, 5,989,925; Providence, 12	7,628,551
Mint.....do....	Callexico, 58; Douglas, 65; El Paso, 316; New York, 2,988	3,427
Mustard.....do....	Callexico, 11,119; Douglas, 4,253; Eagle Pass, 6; El Paso, 1,634; New York, 765; Nogales, 8,007	25,784
Nectarine.....do....	New York, 2,349	2,349
Okra.....do....	Brownsville, 35,949; Key West, 32,349; Laredo, 315; New Orleans, 561,909; New York, 278,430; Nogales, 42; Tampa, 19,710	928,704
Onion.....do....	Boston, 11,934,074; Brownsville, 30,415; Callexico, 3,714; Douglas, 17,344; Eagle Pass, 1,407; El Paso, 222,423; Key West, 1,600; Laredo, 378,812; New Orleans, 2,147; New York, 107,664,936; Nogales, 856,121; Philadelphia, 19,800; Providence, 200; San Francisco, 67,508; Seattle, 75,363; Tampa, 750	121,276,614
Orange:		
Under quarantine 56, pounds.	Boston, 2,240; Chicago, 76,620; New York, 70,602; Philadelphia, 560	150,022
Mandarin (quarantine 28), bundles.	Seattle, 47,346; Tacoma, 3,404	50,750
Pachyrhizus.....pounds..	Boston, 270; Los Angeles, 1,500; San Francisco, 37,505	39,275
Parsley.....do....	Douglas, 577; Eagle Pass, 116; El Paso, 21,273; New York, 1,492,525; Nogales, 116	1,514,607
Parsnip.....do....	Douglas, 70; El Paso, 85; New York, 105,916; Nogales, 3	106,074
Partridge berry.....do....	Boston, 1,800; New York, 250	2,050
Peach.....do....	New York, 104,695	104,695
Pear.....do....	New York, 3,375	3,375
Pea.....do....	Brownsville, 957; Callexico, 233; Douglas, 1,102; Eagle Pass, 166; El Paso, 939; Los Angeles, 7,200; New York, 4,505; Nogales, 9,079,544	9,094,646
Pepper.....do....	Brownsville, 320; Callexico, 108; Del Rio, 3,322; Douglas, 21,596; Eagle Pass, 19,095; El Paso, 388,714; Key West, 122,903; Laredo, 45,306; Los Angeles, 29,624; New Orleans, 622,838; New York, 11,277,717; Nogales, 4,840,738; San Francisco, 1,128; Tampa, 17,705	17,391,114
Pigweed.....do....	Douglas, 228	228
Pineapple.....crates..	Boston, 8,006; Key West, 1,064,690; Laredo, 2; Miami, 45; New Orleans, 73,351; New York, 845,167; Nogales, 32; Providence, 11; Tampa, 24,067	2,015,371
Plantain.....bunches..	Boston, 3; Key West, 73,588; Miami, 14,381; New Orleans, 147,065; New York, 49,351; Nogales, 9; Tampa, 211,178	495,575
Plum.....pounds..	New York, 17,420	17,420
Potato:		
Under quarantine 56, pounds.	New York, 6,179,460	6,179,460
Under potato regulations (order of Dec. 22, 1913), pounds.	Callexico, 13,057; Douglas, 1,998,785; Key West, 153,970; Naco, 9,960; New Orleans, 111,420; New York, 1,885,897; Nogales, 149,736	4,322,825
Prickly pear.....pounds..	Callexico, 95; Eagle Pass, 12; El Paso, 545; Laredo, 2,770; Nogales, 538	3,960
Pumpkin.....do....	Brownsville, 40; Callexico, 90; Douglas, 577; Eagle Pass, 1,583; El Paso, 9,557; Key West, 26,249; Laredo, 5,503; New York, 115,019; Nogales, 2,266; Tampa, 15,298	176,182
Purslane.....do....	Douglas, 137; Nogales, 502	639
Radish.....do....	Callexico, 188; Douglas, 2,133; Eagle Pass, 253; El Paso, 23,140; New York, 204; Nogales, 7,646	33,564
Roselle.....do....	Nogales, 440	440
Salsify.....do....	New York, 200	200
Sea onion.....do....	New York, 1,100	1,100
Sorrel.....do....	New York, 392	392
Spinach.....do....	Callexico, 2,622; Douglas, 12,506; Eagle Pass, 28; El Paso, 59,042; Nogales, 22,659	96,857
Squash.....do....	Brownsville, 450; Callexico, 1,687; Douglas, 4,653; Eagle Pass, 494; El Paso, 37,171; Key West, 3,195; Laredo, 100; New Orleans, 7,410; New York, 449,924; Nogales, 29,234	534,318
Strawberry.....do....	El Paso, 140; Laredo, 1,039; Nogales, 6	1,185
Swiss chard.....do....	New York, 1,085	1,085
Tamarind bean pod.....do....	El Paso, 98; New York, 32,130	32,228
Tangerine.....do....	New York, 23,049	23,049
Thyme.....do....	New York, 46	46

<sup>1</sup> Prohibited importation from Mexico after June 24, 1926, at all border ports from El Paso, east.

TABLE 24.—*Fruits and vegetables imported during year ended June 30, 1926, by ports of entry—Continued*

Kind	Port and quantity	Total
Tomato.....pounds..	Brownsville, 9,934; Calexico, 17,021; Del Rio, 64; Douglas, 11,762; Eagle Pass, 19,391; El Paso, 155,088; Key West, 2,094,430; Laredo, 519,671; Los Angeles, 1,500,762; Miami, 344,976; New Orleans, 2,273,019; New York, 13,786,358; Nogales, 62,352,606; San Diego, 33,736; San Francisco, 463,541; Tampa, 75,516; Tia Juana, 1,040.	83,658,915
Turnip.....do....	Calexico, 133; Douglas, 8,173; Eagle Pass, 129; El Paso, 124,636; New York, 39,876; Nogales, 11,791.	184,738
Udo.....do.....	San Francisco, 650.	650
Vaccinium (cranberry, etc.), pounds.	New York, 16,048; San Francisco, 4,410.	20,458
Water chestnut...pounds..	Boston, 15,352; Chicago, 19,900; Los Angeles, 9,500; New York, 153,595; San Francisco, 534,859; Seattle, 326,221; Tacoma, 7,000.	1,066,427
Water cress.....do....	Douglas, 1,366; Nogales, 1,204.	2,570
Water-lily root....do....	Boston, 600; Chicago, 550; New York, 7,164; San Francisco, 51,989; Seattle, 30,043.	90,346
Watermelon.....do....	Brownsville, 81,873; Calexico, 75; Douglas, 663; Eagle Pass, 2,135; Hidalgo, 9,600; Key West, 117,212; New York, 4,006; Nogales, 546,530.	762,093

TABLE 25.—*Importations of brooms and broomcorn, by country of origin and port of entry, 1925-26*

Country	Brooms	Broomcorn		Total	
	New York	Boston	New York	Brooms	Broom-corn
		<i>Bales</i>	<i>Bales</i>		<i>Bales</i>
Hungary.....		1,711	142		1,853
Italy.....	162 bales, 2 packages..	584	955	162 bales, 2 packages..	1,539
Jugo-Slavia.....	710 bundles.....			710 bundles.....	
Roumania.....	23 cases, 7 bundles....			23 cases, 7 bundles....	
Total.....	162 bales, 717 bundles, 23 cases, 2 packages.	2,295	1,097	162 bales, 717 bundles, 23 cases, 2 packages.	3,392

Plants and plant products under restriction but enterable under permit and inspection, are constantly being brought to the ports of entry by travelers and others in noncommercial lots. The entry of these during the year has involved the inspection of the material and the issuance of 1,415 emergency permits.

In addition to the regulated imports for consumption entry recorded in the foregoing tables, the board supervised the entry under permit, for immediate

exportation or immediate transportation and exportation in bond, of great quantities of plants and plant products involving 2,295 imports. Among some of the principal items may be mentioned approximately 4,000,000 bulbs, 18,650,000 pounds of onions, 2,400,000 pounds of garlic, 5,380,000 pounds of tomatoes, 136,000 crates of lemons, 105,000 crates of pineapples, 643,000 pounds, 41,880 bags, and 6,772 barrels of potatoes, and 10,000 crates and 49 carloads of oranges.











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## ANNUAL REPORT OF THE DIRECTOR OF THE FIXED NITROGEN RESEARCH LABORATORY

UNITED STATES DEPARTMENT OF AGRICULTURE,  
FIXED NITROGEN RESEARCH LABORATORY,  
Washington, D. C., September 13, 1926.

SIR: I have the honor to submit the annual report of the Fixed Nitrogen Research Laboratory for the fiscal year ended June 30, 1926.

Respectfully,

S. C. LIND,  
*Associate Director,  
Acting for F. G. Cottrell, Director.*

Hon. W. M. JARDINE,  
*Secretary of Agriculture.*

This is the seventh year of operation of the laboratory and its fifth year under the Department of Agriculture. The downward trend in the price of synthetic ammonia which set in last year has continued. The decisive step has not yet been taken in its introduction into fertilizer material, but with the plant capacity now finished and under construction, saturation for all uses outside of agriculture will have been reached. Operating experience and cost data will also have been accumulated sufficient to enable the producer to determine whether it is feasible to expand into the fertilizer field. Owing to the competition that will be met in by-product ammonia, the progress of expansion may be delayed, but unless by-product ammonia production increases more rapidly than the use of nitrogen fertilizers, the entrance of synthetic ammonia into fertilizer material can not be long postponed. In any case the agricultural industry should be benefited by the competition.

The service which the laboratory renders to industry has continued to increase and one phase has expanded to the point of constituting a menace to the laboratory. Reference is made to the heavy draft which the synthetic ammonia industry has made upon the laboratory for technical men. Separations during the past year have

amounted to between one-third and one-half of the entire technical staff; the average rate of increase in compensation was 55 per cent, the range being from 22 to 95 per cent increase. Although the training of technical men is regarded as one of the normal contributions of the laboratory in furthering the industry it may be questioned whether the laboratory can continue to support a draft at this rate. On the other hand, a very active and progressive state in the industry is indicated, both through the number of men needed and the salaries which the industry can afford to offer.

### THE DIRECT SYNTHETIC AMMONIA PROCESS

The direct synthetic ammonia process has expanded in the United States during the present year. Two new plants have been put into operation, two others are building, and one or two have increased their capacities. The plant which was put into operation last year, utilizing the laboratory's process and design, has operated successfully throughout the year. The long life of the catalyst has been especially gratifying. Although cost data have not been available, indirect estimates would indicate a very favorable cost.

The introduction of the Claude process in this country by Lazote, the nitrogen subsidiary of the Du Pont Co., may be regarded as the most important development of the year. This process, although a modification of the original Haber process, nevertheless involves decided departures and many novel features. The operation pressure is 900 atmospheres. Water gas made directly from coal is the source of hydrogen, which is separated from carbon monoxide by means of the Claude refrigeration system. The successful operation of several units in the plant since early in 1926 marks one of the milestones of progress in the synthetic ammonia industry in the United States.

With the rapid development of the synthetic ammonia industry in this country the laboratory has been able to devote more of its time and energy to the consideration of the fundamental problems connected with it. The experimental work on the physical properties of compressed gas mixtures has been prosecuted vigorously. The compressibility of mixtures of hydrogen and nitrogen has been determined, as well as the saturation concentration of water vapor in the compressed gases. This type of investigation promises to become of increasing importance not only in supplying industry with important quantitative data but also as a theoretical contribution to our knowledge of the gaseous state at high pressures.

### PRODUCTION OF HYDROGEN

Owing to the importance of the item of cost of hydrogen for nitrogen fixation, the laboratory has continued to devote attention to the possibility of further improvements. Work has been continued on the production and testing of catalysts suitable for the water-gas reaction used to convert the carbon monoxide of water gas into hydrogen by the interaction of steam in the presence of a catalyst. Since this reaction produces carbon dioxide its removal by scrubbing with ammoniacal solutions of ammonium salts has been the object of a study, the results of which will be contained in a forthcoming publication. In connection with the purification of hydrogen an investigation has been made of the catalytic efficiency of certain materials for the removal of carbon monoxide by conversion to methane.

In industry the outstanding developments in hydrogen production have been (1) the decision of the Du Pont Co. not to recover hydrogen from coke-

oven gases as a by-product but to use West Virginia coal for the direct production of water gas, which is then liberated and separated by the Claude system, and (2) the extension of the use of by-product hydrogen into a new field. In the bacterial action by which butanol is obtained, large volumes in equal proportions of carbon dioxide and hydrogen are evolved. Since the carbon dioxide can be readily separated, a pure form of hydrogen suitable for ammonia synthesis is at hand. The Commercial Solvents Corporation, of Peoria, Ill., is now having a 15-ton ammonia plant erected to utilize this source of hydrogen.

Another future possibility is the by-product hydrogen obtained in cracking gas for the production of carbon black. Some problems involved in this utilization have not as yet been worked out. The laboratory is carrying out some researches to that end.

### THE AMMONIA CATALYST

Progress has been marked by the opportunity to observe the actual use of a laboratory catalyst under commercial conditions, on the one hand, and to extend the laboratory investigations into the fundamental aspects of contact catalysis. Results have been attained in both of these directions. The catalyst in commercial use appears to have a long life, the limit of which has not yet been determined, but will probably prove to be longer than a year under good operating conditions.

### METHODS OF NITROGEN CONVERSION

Of importance second only to the fixation of nitrogen is the conversion of the primary products of fixation into compounds which best meet the requirements of agriculture and the chemical industries. For fertilizer use, a salt of high nitrogen content which possesses suitable physical properties is most desirable. In this connection the laboratory has been carrying on development work on the synthesis of urea from ammonia and carbon dioxide. The work has been concerned with large-scale experiments with a small urea plant set up in conjunction with equipment for the production of hydrogen by the catalytic water-gas process. A novel feature of the urea process which involves the initial separation of carbon dioxide from the converted water gas and the subsequent separation of carbon dioxide and ammonia as part of the urea conversion cycle has been worked

out successfully by treating the gas mixtures with a solution of ammonium nitrate. Additional work remains to be done on the urea conversion itself which involves the reaction between carbon dioxide and ammonia at about 150° C. and under a pressure of about 100 atmospheres.

The oxidation of ammonia as the connecting link between ammonia and nitrates is growing in importance with the increased production of synthetic ammonia. In Europe much of the demand for nitrate nitrogen in agriculture and industry is now being supplied by this process, with the result that the consumption of Chilean nitrate has greatly decreased. This transformation process presents attractive possibilities for improvement, particularly as regards the conversion of the initial product of ammonia oxidation, nitric oxide, into nitric acid. The laboratory has continued its study of the reactions involved with a view of facilitating the recovery of the nitrogen oxides in usable form. Along the same line an investigation has been begun on the possibility of increasing the concentration of nitrogen oxides in the gases resulting from ammonia oxidation as a means of producing liquid nitrogen peroxide which could then be converted to nitric acid as a separate step. Preliminary studies have also indicated that liquid nitrogen peroxide may have attractive possibilities as a direct nitrating agent.

### GENERAL STUDY OF CATALYSIS

The fundamental study of catalysts and catalytic processes has been continued as a means of adding to our knowledge of catalytic reactions, which play such an important part in the nitrogen fixation problem. An investigation of the poisoning action of oxygen on ammonia catalysts has given us a much clearer picture of the nature of the catalyst surface and the effect of catalyst promoters. Information of importance in interpreting catalytic phenomena has also been furnished by a study of the decomposition of ammonia at low pressures.

### THE BACTERIAL FIXATION OF NITROGEN

Studies have been continued on the nature of the constituents present in certain plant extracts and elsewhere, which act as growth promoters for legume-nodule bacteria. The data show that the active principle has many properties in common with water-sol-

uble vitamin B, but its exact identity has not been established. It has been determined further that various strains of the legume bacteria respond differently to the active principle. With most newly isolated strains the response is slight, but after continued growth on artificial media containing the active principle the effect usually increases and in some instances the growth is many times greater than in its absence. An extensive study of the bacteria from the standpoint of nitrogen fixation when grown both in the presence and absence of the active principle has failed to show any definite proof that the organism uses free atmospheric nitrogen under any conditions except where growing in its normal environment in the root nodule. It seems, then, that both the legume plant and the bacteria play a vital rôle in the fixation process.

### EQUIPMENT

The high pressures of the direct synthetic ammonia process are new to American industry. Much of the equipment can not be obtained commercially and has to be specially designed. Some such equipment worked up by the laboratory has proved entirely satisfactory and is now available to and in actual use for other operations as well as for the production of synthetic ammonia.

#### HIGH-PRESSURE CYLINDER CLOSURE

A type of closure, fashioned somewhat after the breech mechanism of the larger guns, has proven very successful for maintaining such gases as hydrogen and ammonia when subjected to the higher pressures and temperatures. This is a simple, positive type requiring but a flat metallic gasket. The pressure bolts, being in compression, in case of failure due to over-stressing permit of easy release of the contained gas pressure rather than explosive release with its attendant hazards. This design is such that any expansion and contraction of the materials due to heating and cooling, which ordinarily cause a leak, are automatically and immediately compensated.

#### RELIEF VALVE

Any system containing gases at high pressures should be safeguarded with efficient relief valves. No valves were available commercially for the pressure involved in ammonia synthesis. A valve has been developed which has proven valuable to other industries as



well. This valve can relieve thousands of times in succession, seating absolutely tight after each relief, thus protecting both life and equipment.

#### ROD AND VALVE PACKING

Difficulty was experienced with commercial packings for pump and compressor operation at these pressures. It is very necessary, especially with a valuable and combustible gas like hydrogen, to prevent leakage. Such a packing is being worked up which is proving satisfactory. Unlike other packings, this one needs to be "made up" only hand tight and will still maintain hydrogen at the higher pressures without leak.

#### PLATE VALVE

A plate valve developed for use in pumps operating at relatively high pressures has proven much more efficient than the ordinary poppet type of valve. This plate valve is of large diameter, thus necessitating an exceptionally small lift, permitting of a knife edge seat and thus line rather than surface contact.

#### HIGH-PRESSURE COMPRESSOR

A small research-size compressor is being worked up for compressing gases to 15,000 pounds per square inch directly. This will permit of research work at such a pressure without the necessity of the slow method of compression through the medium of a water plunger. There is at this time no equipment of this nature commercially available.

Much other equipment for extreme conditions has been developed for both specific and general use. All these designs have been made available to the public, and wide use has been made of them by various industrial companies, both for commercial operation and research work. By having these designs available, organizations starting into research work on gases at higher pressures have saved considerable time.

#### DIRECTOR'S VISIT TO EUROPE

The director of the laboratory made a trip to Europe in April, 1926, with the object of visiting nitrogen fixation plants in the various countries where this industry has been developed on a tremendous scale. The outstanding feature of the European situation appears to be the continued development of nitrogen fixation on

an enormous scale. The synthetic-ammonia process continues to be the one most favored, and there has even been some conversion of cyanamide plant equipment to operate some of the newer methods of synthetic ammonia. Production of nitrogen compounds in Germany has already expanded beyond present needs and bids fair to do so in France and England. The consequent necessity for exportation has led to active sales propaganda, which was the keynote of the Biarritz conference. The Orient, principally India and China, seem to be regarded as the most promising outlet for the excess of European fixed nitrogen.

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## REPORT OF THE FORESTER

UNITED STATES DEPARTMENT OF AGRICULTURE,  
FOREST SERVICE,  
Washington, D. C., October 11, 1926.

SIR: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1926.

Respectfully,

WILLIAM B. GREELEY, *Forester.*

Hon. W. M. JARDINE,  
*Secretary of Agriculture.*

### FOREST LAND OWNERSHIP

Unstable forest land ownership is to-day the greatest single obstacle to the rapid spread of timber growing throughout the country. It is represented by the land speculator, or the lumber company which intends to dispose of its holdings when cut over, or the State without a policy of permanent forestry for its timberlands, or the State, county, or town which is anxious to have tax-reverted lands chiefly valuable for timber growing put back on the assessor's rolls. If all or most of the 470,000,000 acres of forest land in the continental United States—close to one-fourth the entire land area—were in the hands of owners whose future returns rested on actual use of the land, the Nation's forest problem would be much nearer solution.

There would still be necessary, of course, the prosecution of research on a large scale and over a long period to learn the best methods of growing timber and of utilizing what the forest produces—just as extensive and continued agricultural research is necessary for better and more profitable farming. In the case of timber growing, research must answer many riddles which now perplex and hold back the landowner. There would be necessary a large amount of educational work to make known the best methods and induce those who would profit by using them to undertake them. There would be necessary public facilitation of timber growing through the removal

of obstacles and economic handicaps, such as the risk of fire damage and of higher taxes than this form of land use can support. These are all essentials of an adequate public program of forestry. But so long as those who hold title to forest land are not interested in making or keeping it usable for timber growing, a fundamental obstacle remains.

### CLASSIFICATION OF FOREST LAND ACCORDING TO OWNERSHIP

The ownership of our forest land is in round numbers as follows:

	Acres
Federal Government.....	89,000,000
States .....	10,500,000
Municipalities and counties.....	700,000
Private owners, large....	220,000,000
Private owners, small ---	150,000,000

From the standpoint of stability, the holdings of municipalities, small private owners, and the Federal Government rate relatively high. State holdings vary from highly stabilized to wholly unstable. Large private holdings are in the main unstable, but with strong evidence of a trend toward greater stability. This trend constitutes the most significant feature of the present forest situation in the United States.

### THE NEED FOR MORE PUBLIC OWNERSHIP

Ultimately it is probable that public ownership and stable management of



at least one-third of the total forest area of the country will be found advisable. Under the policies defined by the Weeks Act of 1911, the Clarke-McNary Act of 1924, and the forest exchange act of 1922, the present national forests should be consolidated, extended over the remaining public domain that is valuable chiefly for timber production, and enlarged, through purchase, in regions where serious forest denudation must be overcome or national interests like the conservation of water flow protected. It is not desirable, however, to purchase additional Federal holdings in regions where local needs can be met by State or municipal forests or by the extension of farm and industrial forestry.

State and municipal forest holdings are now far behind the extent desirable if not imperative in bringing general stability into our forest-land ownership as a whole. Since municipal (town and county) forests are not likely to contribute in the aggregate a large area to the public ownership of forest lands, it is to the extension of State forests that special attention and effort should be directed.

#### STABILITY OF FEDERAL HOLDINGS

The Federal Government now owns one-fifth of the forest land in the continental United States. Of this total about nine-tenths is under stable administration having definitely in view forest preservation and public use, in one form or another. This includes both national forests and national parks. In addition, forested portions of Indian reservations totaling close to 6,000,000 acres are under administration as permanent forest lands but without definite decision as between continuing Federal ownership or eventual disposal. Further, the act of June 7, 1924, made provision for acquainting Congress with the location of public lands suitable for adding to the national forests. On the whole, substantially all the forest lands now in possession of the Federal Government can be counted as reasonably sure to remain in stable ownership; and the same policy will be applied on all lands acquired by purchase hereafter.

#### STATE POLICIES OF FOREST LAND OWNERSHIP

In the adoption of permanent forest land ownership and land management most of the States are far behind the Federal Government. Of the

State-owned forest lands a little more than 5,500,000 acres, or 63 per cent, is under administration for public purposes, while nearly 5,000,000 acres more are either subject to private acquisition or being held without final determination of policy. Yet the States moved before the Federal Government to inaugurate public forest ownership.

In 1872 New York created a commission to consider State ownership of "the wild lands lying northward of the Mohawk, or so much thereof as may be expedient"; and the beginnings of the present Adirondack and Catskill forest preserves date from 1885. In 1876 Colorado became a State; its constitutional convention memorialized Congress asking for the transfer of the public timberlands in the Territory to the care and custody of the State, and its constitution provided that the general assembly should enact laws to preserve the forests upon the State's lands, or upon public domain lands placed under its control. California created a State board of forestry in 1885, which urged in its first report that all Government and State timberlands not fit for agriculture be permanently reserved and the cutting of timber placed in the hands of National or State forestry officers; and the legislature in 1888 passed a concurrent resolution praying Congress to stop the disposal of all Government lands in California with a view to their permanent preservation as a forest reserve for the protection of the watersheds of the State.

Other forms of State forestry legislation and activities began still earlier. Laws aimed at the control of forest fires had their historical antecedents in colonial times. Michigan and Wisconsin both inaugurated inquiries on their State forest conditions and needs in 1867. In 1869 the Maine Board of Agriculture appointed a committee to report on a forest policy for the State, and three years later a law "for the encouragement of the growth of trees" exempted from taxation for 20 years lands planted to trees. Laws offering tree planters either bounties or tax exemption were passed between 1868 and 1872 in Connecticut, New York, Minnesota, Wisconsin, Iowa, Missouri, Dakota, Nebraska, Kansas, and Nevada—all before the first Federal timber culture act. Forestry bureaus or commissions were inaugurated in a number of States in the eighties. These are examples merely.

It was the Federal act of 1891 authorizing the President to create for-

est reserves, the act of 1897 providing for the administration of these forests, their rapid upbuilding under President Roosevelt, and the inauguration in 1911 of the policy of land purchase to add to their number that has placed the Nation so far ahead of the States in permanent forest-land ownership and management. Coincidentally other forms of Federal activity in forestry have been greatly enlarged. Public attention has been centered on forest conservation as primarily a national problem, to a degree which has tended to place unduly in the background the concurrent need for more localized action and the nature of the immediate interest of each community, commonwealth, and region in permanent forest resources.

At the present time the policies of the various States with regard to forest-land ownership show the widest divergence. New York has over 2,000,000 acres (17 per cent of its forest land area) in State forests and parks, and is gradually adding more lands through purchase. It began withholding from sale tax-defaulted lands in the Adirondacks 43 years ago and in consequence had even at that time a nucleus of 600,000 acres toward the forest preserve. Pennsylvania has over 1,000,000 acres in State forests and parks and is contemplating extensive further purchases, likely to lead ultimately to State ownership of approximately 40 per cent of its forest land area. All three of the Lake States have large State forests, but none of them has adopted a clear-cut policy for holding tax-defaulted lands or timberlands received through Federal grants and consistently blocking them up into suitable administration units. Several of the far Western States have obtained or are now acquiring such units through exchanges of their scattered school lands within the national forests for solid blocks of timberland, and have in view permanent retention and management of these lands. All told, 29 States have either State forests or State parks, or both; but as yet only 8 States have as much as 100,000 acres so reserved, and 15 have less than 10,000 acres each.

State activities in forestry have, with a few notable exceptions, developed with other ends primarily in view than the administration of public forest properties. Usually State foresters have at first been appointed to serve as agencies of information, education, and advice to private owners. When administrative functions were added they generally concerned the

organization and maintenance of State systems of protection against fire. Through the enactment of the Weeks Law in 1911, providing for Federal cooperation with the States for this purpose, the protective work was greatly stimulated and enlarged. But the time has come for the States to grapple in earnest with that part of their problem which can only be met through public forest ownership.

The purchase policy of the Federal Government does not contemplate removal from the States of this duty of public forest management. It is intended to be cooperative in spirit and method: to seek common counsel with the States, and a correlation of Federal and State acquisition activities under a general program advancing all interests concerned. The public interests in forestry must be taken care of not as primarily a Federal matter, nor as primarily a State matter, but through a working partnership. This is in accordance with one of the basic principles which the Forest Service has always sought to apply, of avoiding undue centralization and of developing localized activities under a unified program.

The States have obtained their present forest lands partly through Federal grant, partly through tax default, partly through purchase and gift. A formidable obstacle to putting all their present holdings and additional lands reverting through tax default under permanent administration is the scattered location of a large part of these lands. In some States constitutional provisions also stand in the way. A further obstacle is the frequent lack of an administrative agency adequately organized and equipped to assure the consistent carrying out of a farsighted policy of land purchase and management. These obstacles must be overcome. The States, which began a half century and more ago to take thought for the preservation of their forest resources, should press forward to early assumption of their full responsibilities for forest-land ownership and management.

For this it is essential that the forest needs of each State individually receive the public attention that their importance deserves. The movement for a national policy of forestry has made gratifying progress. The same can not be said with regard to State policies of forestry in many instances. During the past year the Forest Service has sought to encourage localized effort for forestry, to increase the study of local problems, and to de-



velop local movements and leadership. It will continue and further emphasize this phase of its work.

#### FOREST POLICIES OF LARGE PRIVATE OWNERS

Unstable private ownership of forest land needs to be thoroughly studied. Present knowledge of its extent, the specific reasons for it, and what can and should be done to lessen it are inadequate. Economic conditions are tending to replace unstable ownership with stable, and both from this and from other causes the situation is changing—possibly faster than is recognized. Public policies can hasten or retard the rate of change. They should be shaped in the light of certain knowledge rather than surmise.

A great deal of the present instability of ownership is due to special conditions which make it impracticable for particular individuals to handle their forest properties as permanent investments. Obligations must be met, going operations carried forward, the capacity of established plants utilized, plans that have been entered upon put through, though this means stripping from the land all that can be manufactured and leaving it bare of forest capital other than the very smallest growth. Unquestionably also privately owned timberlands do not always afford sufficient prospects of financial return under permanent management to constitute a promising investment, at least under present conditions. The hazards arising from inadequate protection from fire or taxation systems ill adapted to timber culture are not infrequently genuine deterrents. On the other hand, failure to appreciate the economic trend of timber supply and timber values is often the reason why commercial timber growing is not undertaken on a much broader scale. To break down this obstacle is primarily a task of education and demonstration—in a broad sense, of salesmanship.

Not so long ago nearly all large private holdings of forest land were in unstable ownership, in the sense that the proprietors did not contemplate permanent retention of title. The changing attitude of the forest industries and timberland owners in this matter is very significant. The point of view of many lumbermen has been that they were engaged in an essential industry—the manufacture of lumber—which necessitated timberland ownership as the source of supply of raw material; that their busi-

ness was utilizing timber, not growing it; and that what might happen to the land after they were done with it did not concern them. That they should be regarded as destroyers instead of producers of wealth seemed to them a distorted, unfair, and monstrous idea. But what happens to the land is certainly of public concern. Open-minded lumbermen are coming to see that if they accept in good faith the idea of self-government in industry they must not ignore a public responsibility created by land ownership. While that is not a responsibility to engage in the business of timber growing as a permanent commitment against their will, nor a responsibility to sink money in unsound ventures, it does impose an obligation to weigh carefully, as business men, the methods of forestry. And that the lumbermen are increasingly ready to do.

In the South, particularly, an evolution appears to be taking place both in the attitude of timberland owners and in actual woods practice that is of very great import. Conditions in the South are peculiarly favorable to industrial timber growing—that is, to large-scale forest management designed to supply the needs for raw material of associated permanent industries. Classing with the South the border States of Maryland, West Virginia, Kentucky, and Missouri, this group of 16 States contains 48 per cent of the forest land in the entire country. Three-eighths of their total area is forest land. Relatively little of this will make agricultural land. Because of the rapid growth of timber in these States, the certainty of large markets relatively near or easily reached, and other advantages the opportunities for good returns on capital engaging in this form of enterprise seem exceptionally promising. The development of timber growing as a permanent land usage is fundamental to the future prosperity of the region, and hardly less important to the country at large.

Southern pine constitutes 70 per cent of the present lumber output of the region, and it is on the southern-pine land that the early introduction of timber growing is most urgent. If cut over without provision for obtaining regrowth and then left unprotected and uncared for, the pine lands decline in productive possibilities. The southern-pine forests also support the great naval-stores industry of the South and provide material for a growing pulp and paper industry.



Together, the lumber, naval stores, and pulp and paper industries of the South reported in 1923 products valued at more than \$760,000,000. All three industries are turning toward forestry as a means of providing for their future requirements. Nevertheless, to imagine that economic trends and private initiative will of themselves take care of the situation would be a serious mistake.

The South is decidedly behind any other part of the country in public provision for forestry, in public realization of its importance, and in the thought and customs of the rural population with regard to fire. Forest lands under public administration comprise all told less than 2 per cent of the forest area of the 16 States. This small fraction is made up of 3,291,000 acres of national forests, chiefly in Arkansas and the Appalachian Mountains; 61,000 acres of State forests and State parks; and some 83,000 acres of municipal and county forests. Less than one-fourth of the total forest area is receiving any degree of public protection against fire, and the combined expenditures of the States, the counties, private owners, and the Federal Government for protection are only about one-tenth the estimated cost of adequate protection. Thus public aid in timber growing is of the most meager character.

The task required to make the South safe for forestry is very great. Stable ownership of private holdings based on continuous use of the land can be largely accelerated through public action. The most important educational need is not merely to show timberland owners what they might do if they would, how to do it, what it would cost, and what returns an investment in timber growing might yield, highly important though this is; the people generally must be brought to realize what forestry requires of them, collectively and individually. Forest fires in the South are to a much larger degree than in any other part of the country deliberately caused, not the result of indifference or carelessness. They are the consequence of a deeply ingrained custom of woods burning. Traditionally, from the time of settlement, in most of the South livestock production has depended upon free range; and with the belief that fire improves the grazing the small farmers have been in the habit of burning the range—that is, the woods—annually. Thus there is an apparent conflict of interest between the local population and large timberland owners

who wish to obtain reforestation. Laws, as well as local custom and individual practices and habits, are involved. If the South is not to see almost one-half its land area failing to contribute adequately to the support of population and the maintenance of prosperity, the States must individually and vigorously develop the policies and create and support the organizations needed to protect their interests.

This holds true not merely for the South. A review of the salient facts for each forest region would make clear that with few exceptions the States have as yet not assumed the part which belongs to them. The spread of industrial timber growing as a permanent use of the 220,000,000 acres of land in the United States now in large private holdings depends to a very large extent on what the individual States do in promotion of their own interests in the matter.

#### A PROGRAM OF ACTION

A few years ago it was a moot question whether a sound public policy of forestry did not require the immediate adoption of measures to regulate forest utilization on private lands. That something needed to be done to substitute timber growing for destructive exploitation was widely recognized. Legislation was proposed looking to regulation by Federal authority. An alternative plan was also proposed for State regulation, to be stimulated by limiting Federal aid in fire protection to States which should adopt and apply adequate regulatory measures. After prolonged deliberation, Congress chose neither course but laid down, in the Clarke-McNary law, a Federal policy of liberal aid to States in fire protection and the promotion of farm forestry and of enlarged national forests. The law made provision also for a study of the problem of forest taxation, generally regarded by large timberland owners and lumbermen as one of the most serious deterrents to stable ownership and industrial forestry. Thus was definitely laid down a course which relies on voluntary individual action under public inducements and assistance along cooperative lines as the most practical means for advancing private forestry.

It should not be forgotten, however, that the policy of Federal cooperation with the States in fire protection adopted under the Clarke-McNary Act has thus far been but partially applied ow-

ing to the limited appropriations available for its execution. That policy contemplated, as a national responsibility, the assumption of a reasonable proportion of the cost of adequate fire protection by the Government—keeping in step with the assumption of the remainder of the burden by the States and private forest owners. In many instances the States and landowners have gone much further toward meeting their quota than has the Nation. In this respect action is lagging, and the vigorous extension of cooperative forest protection contemplated by the law is being partly postponed. A clear obligation rests upon the Federal Government to do its part as promptly as possible toward making the protection policy it has adopted fully effective.

Translated into a program, our progress in forestry involves two groups of public activities. One group seeks to discover and make known the best practices—research and extension. The other group seeks to discover and adopt such public measures as sound policy dictates for the removal of undue obstacles and handicaps.

Activities falling in the first group formed, prior to the transfer of administration of the national forests to the Department of Agriculture in 1905, the main task of the Forest Service. They likewise comprised virtually the sole duties of State forestry departments for a number of years. From 1905 to 1920, however, the energies of the Forest Service were of necessity concentrated primarily on the enormous task of getting the Federal public enterprise in forest administration on its feet. To a large extent the State forestry departments have been occupied since the enactment of the Weeks law in 1911 with the development of the administrative functions required for organized protection of forest lands against fire.

Forest administration is still far and away the leading activity of the Forest Service, and always will be. But if a true picture has been painted in what has been said above, an obvious conclusion is that educational work to induce forest landowners generally to take up timber growing where this is the best form of land use, research to discover the best practices and clear the path of removable obstacles, a continued and widened campaign to lessen the evil of forest fires, and general enlightenment on the facts basic to sound State policies of forestry, constitute the most important immediate public need.

To meet this need calls for carefully coordinated effort by all available agencies in a sustained drive under a common program. Especially it calls for united effort by the Federal Government and the State organizations. Forestry is both a national and a local problem, but even the national problem requires for its successful working out, a localized as well as general attack. Each State must have a flourishing forestry movement of its own, based primarily on its individual needs and directed to the realization of a program adequate to its specific situation.

To promote such coordinated effort and the development of a program of action that will enlist all available agencies most effectively, the Forest Service reorganized during the year its informational, educational, and cooperative activities to bring them more closely together and enable them to function as a unit for the extension of forestry, both public and private. The ultimate objective is to bring under permanent beneficial use for forest purposes all of the forest land in the country on which stable management has not begun. The immediately following sections of this report indicate more fully the situation and the program ahead.

### PROGRESS IN STATE FORESTRY LEGISLATION

Although comparatively few of the State legislatures held sessions last year, a considerable advance was made in State forestry legislation. Mississippi created a State forestry commission with authority to appoint a State forester. Similar legislation was again proposed in South Carolina, Florida, and Arkansas but failed of enactment. Virginia created a commission on conservation and development, with power, under approval of the governor, to take over all of the State's forestry activities; and Louisiana enlarged her general forestry governing board to include a representative of those interested primarily in State parks.

New York made available a \$5,000,000 bond issue that had been approved by popular vote in November, 1924, for buying more land within the forest-preserve counties, and also included in the conservation fund over \$30,000 for the acquisition of nonagricultural areas outside of these counties, to be used, among other purposes, for demonstrating forest management. Massachusetts authorized additional



forest-tree nurseries. Louisiana appropriated \$1,000 to buy land for a State nursery or other forestry purposes, and also required that an average of two seed trees per acre for every 10-acre plot shall be left standing and unbled when timber is cut or turpintined. Mississippi sought the encouragement of land-owners to leave one seed tree per acre; and also authorized private contributions to a State forestry fund with provision that 90 per cent of the amounts so received must be spent on the land of those contributing and as they direct for reforestation and protection purposes so long as in harmony with the reforestation practices of the United States Forest Service.

The same act authorized the acceptance of gifts of land up to 2 per cent of the area of any county for State forests, and gave consent to acquisition by the United States, through purchase or gift, of up to 25,000 acres for national forests. New Jersey increased from 2 to 10 cents per acre the amount of tax paid annually by the State to municipalities on account of State forests; and also passed a joint resolution endorsing the program of the department of conservation and development for the acquisition of not less than 200,000 acres of wild lands for State forests, and authorized an expenditure of \$250,000 for the purpose whenever made available through inclusion in an annual appropriation act.

New Jersey, Virginia, and Kentucky strengthened their laws for the control of forest fires. Washington, in addition to amending various fire provisions, authorized the director of the department of conservation and development to designate as an extra fire hazard any forest region particularly exposed to fire danger, and to make rules and regulations for its protection. Mississippi vested her State forester with broad powers for the prevention and control of forest fires.

New York enacted a new yield tax law which partly follows the lines of the three earlier acts that it supercedes, and partly follows the lines of the Massachusetts forest-taxation law. Kentucky provided for classifying as Forest reserves privately owned tracts containing not less than 1,000 acres each and devoted to the growing of trees, which thereafter, as long as they remain so classified, are to be taxed on a valuation of not over \$2.50 per acre. The taxes when collected are paid into the State treasury to the credit of a forest-reserve fund. In

addition a 10-per cent stumpage or yield tax is imposed when timber is cut, one-half to go to the State and one-half to the county, to be distributed in the same manner as other taxes. As an offset for loss of current revenues from forest reserves, the counties receive a reduction of the amount due the State under the general tax laws, equal to the ad valorem tax annually assessed by the State upon such properties.

In California, Minnesota, Washington, and Louisiana important constitutional amendments concerning the taxation of growing forests will be voted upon at the general elections in November; and in Wisconsin a proposed amendment for a like purpose, which was adopted by the legislature in 1925, will come for approval before the legislature to be elected this fall. If so approved it will be voted upon by the people at the next election.

The above summing up of recent legislation by the States shows advance all along the line. This is especially marked in the strong trend toward giving reforestation a dominant emphasis, in the efforts to reduce fires, and in attention to the tax problem. With legislative emphasis plainly laid upon these three vital points it can not be doubted that the States are making real progress.

### COOPERATION WITH THE STATES IN FORESTRY

Cooperation with the States under the provisions of the Clarke-McNary law, enacted in June, 1924, became effective on July 1, 1925. This law followed the recommendations made to Congress by the Select Committee on Reforestation, after its nation-wide survey of the timber situation. The law seeks to promote forest production on the 80 per cent of the total forest area of the country which is privately owned. It provides for formulation of the protective measures necessary to keep the forest lands in each State productive; for protection from fire of timbered or forest-producing lands or watersheds; and for the study of forest taxation. It stimulates farm forestry by making available forest tree seeds and planting stock as well as assistance in timber growing and the management of woodlands on the farms. In all of these the law authorizes and directs co-operation with the States. Its obvious purpose is to link the Nation and the States in a united effort to develop private timber-growing on the widest possible scale.



Forty-one of the forty-eight States, and the Territories of Hawaii and Porto Rico, are now cooperating with the Federal Government under one or more sections of the law.

The study of forest taxation contemplated by the law is still at an early stage. Details concerning what is being done will be found on page 42. Work under the other sections of the law calls for brief comment here.

#### STUDY OF PROTECTIVE REQUIREMENTS

Section 1 of the law authorized and directed the Secretary of Agriculture, in cooperation with the various States or other suitable agencies, to recommend for each forest region of the United States such systems of forest fire prevention and suppression as will adequately protect the forest lands. During the year the situation was canvassed to determine in a broad way the protective requirements of the several regions and to ascertain the attitude of the individual States. It is planned, following such investigations as may be necessary, to embody in brief publications specific discussions of the more important economic phases of the forest problem of each forest region, their relationship to fire control, and recommendations for permanent and adequate protection. The purpose of these publications is to make clear existing forest-fire control problems in order that the proper protective systems or measures may be developed and applied. Publications covering Idaho and Florida were prepared. In the Pacific Coast and Northwestern States committees representing the State forestry organizations, the lumber industry, timber protective associations, and other interested agencies will work out with the Forest Service the scope of the proposed publications and will cooperate in their preparation and distribution.

In the East the work undertaken is in the nature of a fact-finding survey for each State, conducted by the State forestry officials and the Forest Service. This survey aims to bring together in definite form all information bearing upon the various phases of forest-fire control. When assembled this information will constitute a reservoir from which material may be drawn for various State or State and Federal cooperative publications. At

the same time it will afford a basis for specific recommendations by the Forest Service in cooperation with the States regarding the adoption of measures necessary to meet each major protection problem.

Plans for formulating adequate protective measures in all other forest regions are well under way. In general the trend is toward State publications prepared in accordance with the ideas of all interested agencies as expressed through conferences or committees.

#### PROTECTION OF STATE AND PRIVATE FORESTS FROM FIRE

The Clarke-McNary law has materially increased the scope and effectiveness of the fire-control work in many of the previously cooperating States, and has stimulated new States to cooperate. During the year Missouri, Oklahoma, and Georgia qualified as cooperators. Cooperation with Mississippi became effective July 1, the necessary laws having been passed and funds appropriated at the last session of its legislature. The inclusion of these States marks notable progress toward the conservation of our national timber supply, since they are in important timber-producing regions and have an aggregate area of nearly 60,000,000 acres of forest land. Of the Southern States only South Carolina, Florida, and Arkansas have yet to pass the requisite legislation to qualify for cooperation. They will probably take action during 1927. Of the 39 States having important timber resources, 33 are now cooperating in the effort to provide adequate protection from fire to their 330,000,000 acres of State and private forest land.

A Federal appropriation of \$660,000, State funds amounting to \$1,800,000, and \$465,000 in private funds to be disbursed by the States or under their supervision were available for cooperative expenditure. Additional expenditures for forest-fire protection to an amount in excess of \$1,000,000 were made during the year by private owners or associations.

The allotments to each State during the past year, including emergency allotments to States that experienced unusually severe fire seasons, are shown in Table 1.

TABLE 1.—*Cooperative expenditures in fire protection and the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1926*

States	Fire protection				Distribution of forest planting stock		
	Federal	States	Private agencies	Total	Federal	State	Total
Maine.....	\$26,925.02	\$114,043.66		\$140,968.68			
New Hampshire.....	7,329.97	25,988.11		33,318.08	\$2,000.00	\$6,266.00	\$8,266.00
Vermont.....	5,129.32	6,403.70		11,533.02	2,000.00	8,126.24	10,126.24
Massachusetts.....	14,630.00	58,267.16		72,897.16	1,991.95	7,967.76	9,959.71
Connecticut.....	6,015.00	28,526.59	\$630.74	35,172.33	1,212.16	1,212.17	2,424.33
New York.....	29,391.73	170,144.20		199,535.93	1,728.85	62,339.57	64,068.42
New Jersey.....	7,445.00	79,682.12		87,127.12	319.00	320.00	639.00
Delaware.....					375.00	375.00	750.00
Pennsylvania.....	35,435.00	101,219.03		136,654.03	1,919.57	60,001.68	61,921.25
Maryland.....	5,710.00	14,633.50		20,343.50	1,593.47	4,159.16	5,752.63
Ohio.....	2,060.00	10,975.80		13,035.80	2,000.00	13,892.24	15,892.24
Indiana.....					1,221.10	2,479.21	3,700.31
Virginia.....	27,240.00	24,261.16	4,860.60	56,361.76	1,000.00	1,053.14	2,053.14
West Virginia.....	12,950.00	24,283.83	10,886.93	48,120.76			
North Carolina.....	29,465.00	30,750.79		60,215.79	1,256.98	1,256.98	2,513.96
Tennessee.....	18,500.00	16,839.52	1,660.48	37,000.00			
Kentucky.....	8,000.00	8,033.64		16,033.64	1,981.34	2,972.01	4,953.35
Georgia.....	3,137.99	3,929.52		7,067.51			
Porto Rico.....					2,000.00	12,911.49	14,911.49
Alabama.....	28,300.00	24,278.65	6,128.76	58,707.41	1,911.09	1,911.10	3,822.19
Louisiana.....	25,320.00	34,107.48	35,067.42	94,494.90	2,000.00	4,158.40	6,158.40
Texas.....	25,666.22	26,821.02		52,487.24			
Oklahoma.....	1,551.37	1,551.38		3,102.75			
Missouri.....	2,000.00	2,414.92		4,414.92	379.72	379.74	759.46
Iowa.....					2,000.00	2,144.58	4,144.58
Michigan.....	48,310.00	206,003.74		254,313.74	2,000.00	5,035.03	7,035.03
Wisconsin.....	23,750.00	26,083.21		49,833.21	2,000.00	2,434.01	4,434.01
Minnesota.....	42,445.66	141,301.81		183,747.47	430.00	430.00	860.00
Kansas.....					2,000.00	3,535.18	5,535.18
Nebraska.....					228.66	228.66	457.32
Colorado.....					1,404.36	1,592.84	2,997.20
North Dakota.....					2,000.00	3,314.84	5,314.84
South Dakota.....	110.00	4,226.96		4,336.96			
Montana.....	14,807.96	15,412.40		30,220.36			
Idaho.....	35,635.00	183,587.88		219,222.88	280.00	280.00	560.00
Washington.....	33,220.00	88,198.94	77,242.90	198,661.84	1,273.10	1,351.85	2,624.95
Oregon.....	33,525.00	36,490.91	126,470.45	196,486.36	2,000.00	2,159.14	4,159.14
California.....	29,970.00	97,556.98	564.30	128,091.28	600.00	8,984.26	9,584.26
New Mexico.....	1,400.00	5,362.00		6,762.00			
Administration and inspection.....	53,052.35			53,052.35	1,900.00		1,900.00
Total.....	638,427.59	1,611,380.61	263,512.58	2,513,320.78	45,006.35	223,272.28	268,278.63
Forest tax studies.....	8,447.29						
Unexpended balance.....	13,125.12				4,993.65		
Total appropriation.....	660,000.00				50,000.00		

Both the number of fires and the fire losses were materially lower in 1925 than in 1924. This was due partly to a somewhat more favorable season, but chiefly to greater educational efforts and the increased effectiveness of the fire-control organizations. During 1925, 86,000 fires burned over nearly 26,000,000 acres of Federal, State, and private lands, and caused a loss of timber and improvements to the value of \$28,000,000.

Slightly in excess of 90 per cent of the total number of fires were man caused. Incendiarism was again responsible for the greatest number of fires, followed in order by brush burning, smokers, railroads, lightning, campers, and lumbering.

The number of fires reported for 1925, the damage caused, and the area burned in the several forest regions are shown in Table 2.



TABLE 2.—Summary of forest fire statistics, by groups of States, for the United States (exclusive of Alaska), 1925

Group of States <sup>1</sup>	Number of fires		Damage		Area burned	
	Total	Per cent	Total	Per cent	Total acres	Per cent
United States (exclusive of Alaska).....	85,762	100.0	\$28,054,878	100.0	26,518,715	100.0
Northeastern.....	6,923	8.0	1,008,707	3.6	200,238	.8
Appalachian.....	5,087	5.9	1,485,971	5.3	448,291	1.7
Southeastern.....	33,610	39.2	15,182,598	54.1	13,599,688	51.3
East Mississippi.....	3,780	4.4	1,240,201	4.4	481,584	1.8
West Mississippi.....	19,776	23.1	4,905,944	17.5	9,779,767	36.9
Lake States.....	5,811	6.8	2,199,538	7.8	1,418,983	5.3
Rocky Mountain.....	4,038	4.7	753,743	2.7	160,304	.6
Pacific.....	6,737	7.9	1,278,176	4.6	429,860	1.6

<sup>1</sup> Northeastern group: New England States, New York and New Jersey.

Appalachian group: Pennsylvania, Delaware, Maryland, Virginia, and West Virginia.

Southeastern group: North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.

East Mississippi group: Ohio, Indiana, Illinois, Kentucky, and Tennessee.

West Mississippi group: Missouri, Arkansas, Oklahoma, Louisiana, and Texas.

Lake States group: Michigan, Wisconsin, and Minnesota.

Rocky Mountain group: Montana, Idaho, Wyoming, South Dakota, Nebraska, Colorado, Arizona, New Mexico, Nevada, and Utah.

Pacific group: Washington, Oregon, and California.

#### COOPERATION WITH THE STATES IN TREE PLANTING

Section 4 of the Clarke-McNary law authorizes and directs the Secretary of Agriculture "to cooperate with the various States in the procurement, production, and distribution of forest tree seeds and plants, for the purpose of establishing windbreaks, shelter belts, and farm wood lots upon denuded and nonforested lands within such cooperating States." This section of the law was passed to meet a definite need. For a number of years a few of the States had extended assistance to landowners, and particularly to farmers, in reforesting cut-over lands and establishing and improving wood lots. These States established forest tree nurseries to provide planting stock. The demand for young trees constantly exceeded the supply; inadequate appropriations in most of the States limited expansion of the work; and the entire output of the nurseries permitted the planting of only a negligible acreage compared with the 80,000,000 acres of denuded forest lands in need of planting.

Experience has proved that the production and distribution of suitable trees for forest planting is not obtained without public assistance or guidance. The commercial production of such stock is undeveloped in most sections of the country. The State forestry departments and the Federal Government are showing the way by producing these small trees in quantity and at a minimum cost. Thus a de-

mand has been created which greatly exceeds the producing capacity of the State nurseries and which many private companies are now engaged in supplying to a limited extent.

The farmer can not afford to plant his waste lands unless the planting stock can be bought at a low figure. The purpose of the law is to enable him to get the kind and quantity of trees needed for his special uses at a cost which he can afford. Primarily as a result of the offer of cooperation, 14 new States have forest-tree nurseries in operation or in process of development. Thirty-three States and the Territory of Porto Rico are now cooperating, the Territory of Hawaii has indicated its desire to receive assistance, and certain additional States will undoubtedly request cooperation during 1927.

The allotments made to the States cooperating during the year are shown in Table 1.

#### COOPERATION WITH THE STATES IN FOREST EXTENSION

Under section 5 of the Clarke-McNary law the Secretary of Agriculture cooperates with the States or other agencies to assist farmers in growing timber crops and in other forms of farm forestry. The work in carrying out this provision of the law is conducted by the Extension Service of the department in cooperation with the Forest Service. It forms an essential part of the general program of national forestry.



For familiarizing farmers with forest practice and encouraging its adoption the outstanding agency is the State extension organizations created in conformity with the Smith-Lever Act. At the close of the fiscal year these organizations had forestry projects in 25 States. Participation of the State foresters in extension activities is also essential. The degree to which forestry can be extended as a farm practice depends in part upon what services are available from the State forester.

Employment by the State extension services of an extension forester is the first step in the development of definite States programs, covering "projects" on which information will be most valuable to the farmers of the State. For each project selected, a plan of work—that is, a method by which the specific information will be conveyed to those wanting it—is devised. These plans of work make it possible for the county agricultural agents and local leaders to enlist widespread interest in forestry as a phase of diversified agriculture.

Extension forestry projects are being developed for boys and girls. Among the projects of the past year those dealing with the planting of forest trees held a leading place. By far the largest results were achieved in the planting of cleared land in farm ownership but not suitable for cultivation. In many States these idle lands represent a burden of considerable magnitude. Of less importance in connection with future timber supplies, but closely related to farm prosperity, comfort, and attractiveness, is the planting of windbreaks or shelter belts about farmsteads and the establishment of roadside trees. These projects are being pushed in the Middle West and Great Plains region.

Throughout all of the States of the East and South farm demonstrations of the satisfactory care, improvement, and management of woodlands are being given. Closely associated with these demonstrations is the teaching of simple methods of measuring timber, the principles of timber and woodland marketing, and the prevention of damage to woodlands from fire, livestock, fungi, etc. The work has been heartily accepted in most of the States, and gives promise of development comparable with that of other projects in the agricultural extension programs.

#### EXPENDITURES AND RECEIPTS

The expenditures and receipts for all purposes during the fiscal year were as follows:

General administration-----	\$376,988.97
Protection of the national forests:	
Fire prevention and detection-----	1,504,582.49
Fire suppression-----	1,263,899.29
Protection against insects and tree diseases-----	43,950.69
Total-----	2,812,432.47
Administration of current business on the national forests:	
Administration of timber use-----	960,225.44
Administration of grazing use-----	588,353.73
Fish and game protection-----	72,043.55
Administration of recreation and land use-----	104,272.27
Examination of power sites for Federal Power Commission--	35,159.79
Total-----	1,760,054.78
Surveys of lands and resources:	
General surveys and maps-----	134,027.95
Grazing reconnaissance-----	94,161.40
Timber surveys-----	225,816.85
Total-----	454,006.20
Land adjustment and extensions:	
Classification, settlement, and claims-----	94,685.39
Land exchanges-----	136,933.52
Acquisition under act of Mar. 1, 1911, as amended-----	1,009,554.32
Total-----	1,241,173.23
Nurseries and tree planting	173,815.23
Tree planting in cooperation with States under act of June 7, 1924-----	44,881.70
Construction and maintenance of improvements:	
Construction of improvements other than roads, trails, and camp ground improvements-----	615,091.99
Maintenance of improvements other than roads, trails, and camp ground improvements-----	529,314.56
Camp ground improvements-----	39,462.33
Total-----	1,183,868.88
Research:	
Silvical investigations	285,255.40
Forest products investigations-----	593,331.92
Range investigations-----	63,791.29
Taxation study-----	8,447.29
Total-----	950,825.90
Fire protection in cooperation with States under act of June 7, 1924-----	638,427.59
Protection of Oregon and California grant lands--	87,688.69

Road and trail construction and maintenance:	
10 per cent fund under act of Mar. 4, 1913-----	\$677, 935. 88
Cooperative construction of roads and trails under act of July 11, 1916-----	867, 101. 90
Federal forest-road construction under act of Feb. 28, 1919	33, 201. 81
Forest development roads and trails under act of Nov. 9, 1921-----	3, 393, 083. 08
Forest highways under act of Nov. 9, 1921--	5, 059, 865. 44
Road and trail construction from moneys contributed by cooperating agencies under act of June 30, 1914-----	1, 581, 040. 62
Contributed from other appropriations-----	1, 392, 950. 83
Total-----	13, 005, 179. 56
Grand total-----	22, 729, 343. 20

The above statement includes expenditures made by the Forest Service from Congressional appropriations and cooperative funds. It also includes expenditures made by the Bureau of Public Roads for the construction and maintenance of national forest roads.

National forest protection cost approximately \$1,000,000 less than the previous year, in consequence of a more favorable fire season; the smaller expenditures for suppression account for nearly all the reduction. An increase of about \$133,000 in the cost of administering current business was almost entirely due to greater timber-sale activity. On survey work, essential for better protection and use of all the forest resources, the expenditures were increased by about \$52,000. An enlarged acquisition program raised the outlay for land adjustment and extension more than \$200,000. Nurseries and tree planting (for national forest reforestation) showed an increase of 5 per cent, or a little over \$8,000. Tree planting in cooperation with States is a new item, representing the inauguration of this work under the Clarke-McNary law.

Improvements showed increased expenditures of approximately \$133,000. Cooperative fire protection was materially expanded, as a result of an increased appropriation, and the outlay for it rose \$245,000. Road and trail construction and maintenance took \$795,000 less. The grand total was almost \$1,030,000 less than that for the fiscal year 1925.

The road and trail expenditures, constituting as they do 57 per cent of the grand total, call for additional comment. The development of im-

proved highways, minor roads, and trails is an essential prerequisite of efficient administration, protection, and development of the forest resources. In part it is likewise essential to the carrying out of the general plan for a national system of highways. Appropriations are made by Congress in accordance with its recognition of this double need. The general plan of road development authorized and called for under the various laws is worked out by the Forest Service, with the cooperation of the Bureau of Public Roads and State and county officials. The construction of major projects is supervised by the Bureau of Public Roads but the actual disbursements are made by the Forest Service, which also handles the construction of minor roads and trails not calling for specialized engineering supervision. As a part of their regular duties many forest officers devote some time to minor road building and maintenance and to the construction of trails, all of which are vital to effective protection.

The time spent incidentally by guards, rangers, and other officers not paid from road appropriations is charged in the cost-keeping records against the road work of the service. This work is also charged with its proportionate share of general overhead costs, in the ratio which they have to direct expenditures on all classes of work in the field.

The receipts from the national forests were as follows:

From the use of timber----	\$3, 366, 685. 36
From the use of forage----	1, 421, 588. 70
From miscellaneous uses, including the use of land, water-power sites, etc----	367, 386. 96
Total-----	5, 155, 661. 02

The total is greater by \$155,523.53 than that for the previous year. Receipts from timber increased \$426,292.06, while receipts from grazing decreased \$303,788.11. Receipts from miscellaneous uses rose \$33,019.58, mostly through more recreational permits.

The increase in timber receipts was due mainly to a greater cut in the three Pacific Coast States and northern Idaho, where the lumber industry is now drawing most heavily upon the national forests. Timber receipts tend to rise, but fluctuate from year to year in response to market demands for lumber and other products. The total for last year reached a new peak. It was nearly 11 per cent greater than in 1924, the previous high record. Since 1920—which was also a peak



year—the timber receipts have risen more than 66 per cent. In 10 years they have considerably more than doubled.

The decrease in grazing receipts was due almost entirely to the waiver of grazing fees in the drought-stricken regions of the Southwest under special authority of Congress. Conditions in the Southwest improved to such an extent in the spring and summer of 1926 that the payment of all grazing fees was resumed on October 1, 1926, and a substantial increase, in grazing receipts is looked for in 1927.

### NATIONAL-FOREST ADMINISTRATION

The national forests are no longer primeval solitudes remote from the economic life of developing regions, or barely touched by the skirmish line of settlement. To a very large degree the wilderness has been pressed back. Farms have multiplied, roads have been built, frontier hamlets have grown into villages and towns, industries have found foothold and expanded. Although the forests are still in an early stage of economic development, their resources are important factors in present prosperity.

The growing demand for the products of the forests makes skillful handling of the timber, range, and other resources increasingly important. To this need, and to the best way of meeting it, the thought of the entire organization has been strongly turned during the year. While successful handling of the forests demands also business and managerial ability, the care and development of the physical resources is the essence of the administrator's work.

Good physical resource management can not be worked at long range nor obtained by machine methods dictated from above. It must be developed on the ground, through the intelligent planning and individual skill and initiative of those in immediate charge of the properties. One of the needs is for enlargement of the capacity of the personnel for expert physical resource management through instruction and training. The effort to bring this about can not go faster than the requirements of good current work and available funds permit, and is kept within rather narrow limits by the necessity for the strictest economy in every direction. Nevertheless, under the pressure of necessity ways can be found, and are being found, to make some provision for progressive training of the field force.

Efficient management of the timber resource involves better fire control, with special attention to cut-over areas and old burns, a more effective attack upon destructive insects, a greatly expanded planting program, and simple management plans which fix the rate at which timber is to be cut, the location of cutting areas, and the methods of reforestation—all based upon the growing capacity of the forest land. In order to serve the public needs effectively the best practice in the utilization and conversion of national forest timber is sought, partly through the stipulations of cutting contracts and partly through educational methods, experiments, and demonstrations in connection with the research work conducted at the Forest Products Laboratory. A correlation or diversification of wood-using industries built around the raw material available in the national forests is unquestionably one important need. It is the logical supplement of our land-management policy of producing as much wood as possible.

In the development and management of range resources the essentials to be aimed at are stability in range allotments, the development of simple range management plans defining the objects sought on each unit and the specific things required to put them into effect, more effective range inspection, some increase in the number of technically trained grazing men, and the construction of range improvements to permit better range control and utilization.

In managing recreational uses on the national forests adequate funds to keep up with the growing public requirements for camp-ground improvements are seriously lacking. The handling of the water power, recreation, and wild life resources of the forests and their correlation with timber and range use are being provided for as well as possible by simple but definite planning. In the constantly increasing conflicts between two or more uses of the same area, the problem can be handled only by giving preference to the form of use to which the lands are best suited and by which the interest of the public will in the long run be best served.

A program for the next five years has been adopted, which provides for the making of timber-management plans for all working circles where the present or immediately prospective cut either approaches the probable sustained yield or involves an amount of timber or complexity of conditions



making necessary an analysis of the whole situation as a basis for orderly development; for the making of grazing-management plans for each grazing unit in use, based largely on data already obtained through range appraisal and in the course of administration; and for the completion of the plans necessary for the conduct of land exchanges. It is important that the resource plans be kept simple, adapted to the actual needs of administration, and free from refinements not justified by a common-sense dealing with existing conditions. Above all they must be such that the field force will thoroughly grasp and use them. As the individual resource plans are developed, needed points of coordination must always be watched for and dealt with.

#### ECONOMIES IN ADMINISTRATION

The consistent pursuit of economy has enabled the Forest Service to handle an expanding business at relatively small increased cost. The most fertile fields were personnel adjustments to accomplish more work with fewer employees, cooperation with other Government and outside agencies and individuals, the installation of mechanical devices and improvement in methods, reduction in paper work, and short cuts in business practices.

Vigilant care is given to keep the force employed in general administration in the Washington office at the smallest point consistent with the prompt and efficient handling of the business. It was possible during the year to make a redistribution of duties which released \$5,800 a year. In the field organization many adjustments were made which reduced the force. Consolidations of ranger districts and other field and office adjustments cut out more than 30 positions and saved approximately \$40,000. Considerable savings were effected by enlarging the mobility of the field force and flexibility of the organization to take care of special demands and peak loads. In one district \$9,200 was thus saved in timber surveys and timber-sale administration.

Cooperation with other Government and outside agencies brought about material savings. By borrowing an unused caterpillar tractor and a heavy grader from the county authorities the local forest officers completed a road in Colorado for \$5,000 less than the engineer's estimate of \$22,000. In Minnesota \$1,200 was similarly saved on a road project by securing a loan of county equipment and free services.

By enlisting the interest of local commercial concerns in road and trail projects of community benefit materials and equipments were in many instances purchased at reduced prices. These instances are illustrative of the economies, large and small, widely secured through cooperation.

In Alaska the cooperation between various Government and local agencies and the Forest Service is noteworthy. Valuable cooperation was given by the Bureau of Public Roads, the Geological Survey, the General Land Office, the Bureau of Fisheries, and the Department of Justice. An especially valuable form of cooperation is furnished by the United States attorney at Juneau, who acts as legal adviser to the service and thus takes care of work which in other districts is handled by assistants to the Solicitor of the Department of Agriculture.

The cooperation in Alaska is not one sided, however, the Forest Service reciprocating to the extent of its ability. It does a good deal of mimeographing without charge for the Bureau of Public Roads, the Alaska Railroad Commission, and other Government agencies not provided with equipment for such work. It is functioning as a central agency for purchasing certain supplies required in considerable quantity for the combined needs of the service and a number of other bureaus, thereby obtaining materially lower prices. It has made field surveys in southeastern Alaska for the Bureau of Education, for use in land withdrawals. The marine stations at Ketchikan have been utilized by the boats of the Bureau of Public Roads and the Geological Survey in making repairs. This mutuality of cooperation in Alaska is highly effective for economy of administration.

New applications of mechanical devices to construction work have enabled much more work to be done for the same money. An outstanding economy of this kind was accomplished by an increased use of horse equipment in trail construction. A side-hill plow and trail grader invented by one of our own men brought about an estimated saving of \$12,000, although the use of this device began only in midseason. A comparison of the 1924 and 1925 costs showed a reduction of \$100 a mile, and the construction mileage was doubled. The use in road construction of a dump truck which cost \$755, instead of horses and wagons, saved \$1,300 in the first season. Motor trucks have brought about a decided saving of time and funds in reaching fires and

handling equipment and have decreased the outlay for hired cars.

Short cuts in business practices and miscellaneous economies are continually sought for. By issuing grazing permits to livestock associations instead of to their individual members, as hitherto, one permit takes the place of from 100 to 200, with a corresponding decrease of administrative and clerical work. When possible district ranger meetings are held in mountain localities where the men can be lodged and subsisted at very small cost; on one of the forests the meeting was held at an Army post with no expense for lodging. In this way \$1,500 was saved in one district. A garage and storehouse were built by a ranger from materials salvaged from an abandoned mine building and enough lumber was left over to construct a fire-guard cabin to be built this year; the material salvaged would have cost \$400. Much ingenuity is displayed by the field officers generally in economizing time as well as meager allotments, producing savings individually small but amounting to worth-while figures in the aggregate.

These economies have to a limited extent made funds available for the most urgent requirements elsewhere. Through them it has been possible to add some new fire guards at weak points in the protective organization, provide salary increases for individual employees who are below the established rates or whose responsibilities are enlarged, do more to hold down man-caused fires through educational measures of various kinds, reduce the fire hazard by removing or improving dangerous conditions in the woods, build fire-control lines, improve sanitary conditions at public camp grounds, somewhat extend tree planting, and administer new timber sales. Had it not been for the leeway afforded by this means of financing added and imperative responsibilities, it is hard to see how serious breakdowns of efficiency and failures to meet public obligations could have been escaped. For every dollar, however, that can be saved through searching economies and through the ingenuity of the entire organization, there are several places clamoring for its expenditure on essential work. With the best done that can be done to stretch the available appropriations, the service is still far behind requirements.

#### NATIONAL FOREST PROPERTIES

At the close of the fiscal year the net area of the national forests was 158,-

759,210 acres, and the gross area, which includes all private and State owned land within the boundaries, 184,123,951 acres. The net area increased 364,154 acres, while the gross area decreased 1,961 acres, partly through area recomputations based upon more exact surveys and projections.

Additions totaled 69,672 acres. Acts of Congress added 19,905 acres to the Absaroka and 18,418 acres to the Gallatin, in Montana; 4,832 acres to the Washakie, in Wyoming; 2,103 acres to the Colorado; and 684 acres to the Rainier, in Washington. The last two additions were in the adjustment of national park and national forest common boundaries. Five additions, aggregating 23,730 acres, were made by Executive order or proclamation; the most important was an addition of 11,997 acres to the Shasta, in California, under special authority of Congress.

Eliminations totaled 109,775 acres, accounted for mainly by one of 68,160 acres almost all privately owned from the Angeles, in California, one of 7,059 acres from the Missoula, in Montana, and one of 28,059 acres from the Chelan, in Washington, this last being a clear listing of land selected under the State exchange.

#### PROGRESS IN LAND EXCHANGES

Consummated land exchanges added 14,230 acres to the net area. The Secretary of Agriculture approved and referred to the Secretary of the Interior 65 cases contemplating the receipt of 46,636 acres in exchange for 7,040 acres of land and 47,288,390 board feet of stumpage. Pending cases before the Department of the Interior at the close of the year numbered 83. Exchanges with the States of Washington, Oregon, California, Montana, and Colorado are progressing, and one with New Mexico is now in prospect. New land exchange measures enacted by Congress were: (1) Amendment of the New Mexico enabling act to allow a consolidation of State holdings within the forests; (2) authorization of the exchange of national forest lands or stumpage in Arizona or New Mexico for the forested parts of the Mora Grant in the latter State; and (3) authorization of an exchange for certain company lands in the Medicine Bow National Forest, in Wyoming, of an equal value of unappropriated and unreserved public lands in the same State.

The Forest Service has continued its conservative policy in land exchanges,



considering only cases of unquestioned public benefit and advantage.

#### PROGRESS IN LAND PURCHASES

In the East title was taken under the Weeks law to 174,711.14 acres, at an average cost of \$3.69 per acre, or a total cost of \$645,358.97. The National Forest Reservation Commission authorized purchases totaling 141,645 acres, with a valuation of \$687,409.57, or \$4.85 per acre. This is 9 cents below the average for all lands hitherto approved.

The distribution, by States, of the lands fully acquired under the Weeks law is shown in Table 3:

TABLE 3.—*Acreage of timberland acquired in the fiscal year 1926 and total acquired to July 1, 1926, by States*

	Acquired, 1926	Average price per acre, 1926	Total ac- quired to July 1, 1926
	<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>
Alabama.....	480.61	4.68	87,785.38
Arkansas.....	5,554.73	2.92	64,892.14
Georgia.....			159,978.84
Maine.....			32,255.98
New Hampshire..	1,697.72	5.12	408,949.26
North Carolina..	10,373.42	3.77	364,662.57
Pennsylvania....	45,966.29	3.23	149,232.11
South Carolina..	18,352.96	6.92	37,875.50
Tennessee.....	28,389.09	3.56	296,077.86
Virginia.....	60,289.99	3.11	563,927.87
West Virginia....	3,606.43	4.22	222,731.11
Total or average.	174,711.14	3.69	2,388,368.62

The total cost of the lands fully acquired has been \$11,778,788.22, making the average cost per acre \$4.93.

No new purchase units were created, but the Youghiogheny unit of 80,259 acres located in western Maryland was abolished.

An addition was made to the Ouachita unit in Arkansas comprising 96,406 acres, of which about 2,800 acres are unreserved, unappropriated public lands. By recomputation the gross area of the Natural Bridge purchase unit was found to be 390,272 acres instead of 382,575 acres as previously reported. The present purchase areas contain approximately 9,146,143 acres. They include 921,699 acres reserved from the public domain, 11,369 acres transferred from the Treasury Department under a special act, and 2,722,885 acres acquired or in process of acquisition under the Weeks law.

Of the remaining 5,490,190 acres, 1,283,488 acres are known to possess

agricultural, mineral, or water-power values which preclude purchase. The net unacquired forest land in the existing purchase areas is therefore 4,206,702 acres. Some of it is held at prohibitive prices by the owners and some of it is already receiving such care and protection that there is no strong reason for public ownership. Approximately 390,000 acres are now under stable private management.

The year was noteworthy in that it marked the initiation of a program of national forest-land purchases in the Lake States, under the provisions of the Clarke-McNary Act. At its meeting of March 31, 1926, the National Forest Reservation Commission authorized the establishment of the Tawas purchase area, in Michigan, which embraces the Tawas and Mio divisions of the Michigan National Forest and contains a gross area of 616,960 acres, of which 84,860 acres is now in Government ownership; and of the Superior purchase area, in Minnesota, which embraces the Superior National Forest and contains a gross area of 1,628,118 acres, of which 806,681 acres is now Government owned. The commission also approved the purchase from the Michigan Agricultural College of 50,500 acres of land situated in the Tawas unit. Other areas in the Lake States, particularly the Oneida unit in northern Wisconsin and a unit in the upper peninsula of Michigan, are now under consideration as purchase areas.

No purchase units in the southern pine belt have as yet been submitted to the National Forest Reservation Commission, but at the close of the year a final check was being made upon a number of areas previously examined and tentatively selected, with a view to recommending one or more units.

The total of purchases under the Weeks law is now drawing measurably near to 3,000,000 acres of land, situated in 21 purchase units in 11 States. Acquisition of this land has been financially advantageous, while the collateral benefits have been many. It can reasonably be expected that future purchases will be equally advantageous. Federal leadership and participation in redeeming cut-over and denuded forest lands is a prime agency for promoting a sound policy both of public and of private forestry. Its expansion in its present fields and its extension into new fields is necessary as a means of further stimulating forest protection and the stable management of timbered lands.



The program called for is briefly: (1) The completion of the Weeks law forests, including new units in Kentucky and Missouri, through the purchase of an additional 4,000,000 acres at a cost of about \$25,000,000; (2) the acquisition of approximately 2,500,000 acres in the Lake States, at a cost of about \$6,250,000; and (3) the purchase of about 2,500,000 acres in the southern pine States at a cost of probably \$8,750,000. The complete program contemplates the placing under national-forest administration of 9,000,000 additional acres of forest land, much of it at present denuded and in poor condition, but with high potential values for timber production and stream-flow conservation, at a total cost of \$40,000,000.

The appropriation for the purchase of lands during the fiscal year 1927 is \$1,000,000. This is insufficient to permit maximum efficiency in purchase work or reasonable progress in the acquisition of the necessary lands. The National Forest Reservation Commission has for several years recommended appropriations of \$2,000,000 per year. The report of the Senate select committee set \$3,000,000 per year as the desirable minimum. The Woodruff-McNary bill, now before Congress, proposes \$3,000,000 per year for the first five years and \$5,000,000 for the next five. The several agencies suggesting these appropriations have given careful study to the requirements of the situation and have been conservative in the figures they recommend.

The purchase work should go forward along the lines planned, and rapidly. Delay will mean only increased costs and greater difficulty of consolidation. The perfection of an adequate system of national forests, appropriately distributed among the timbered regions of the country, is a pressing need.

#### SPECIAL USES

At the close of the calendar year 1925 30,801 special-use permits were in force, of which 16,220 were paid and 14,581 were issued without charge. The total receipts from special uses amounted to \$259,815.51, a sum greatly in excess of the costs of administration. These figures represent gains over the preceding year of 1,100 in total permits, 837 in paid permits, 263 in free permits, and \$30,579.79 in receipts. The principal uses continue to be hotels, resorts, outdoor camps, summer residences, drift and divi-

sional fences, pastures, reservoirs, and water conduits, but almost every conceivable form of land occupancy compatible with national-forest purposes is allowed. Although only a negligible percentage of national-forest area is occupied by these forms of use they serve large numbers of people in many beneficial ways.

#### COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

Proposals to add national forest lands to existing national parks, or to include them within new national parks, have created for the National Park Service and the Forest Service a common concern in the following projects:

Proposed additions and other boundary adjustments involving the Sequoia National Park, Calif.; Rocky Mountain National Park, Colo.; Mount Rainier National Park, Wash.; Grand Canyon National Park, Ariz.; Yellowstone National Park, Wyo.; Yosemite National Park, Calif.; Lassen Volcanic National Park, Calif.; and Crater Lake National Park, Oreg.

Proposed new national parks: Cliff Cities National Park, N. Mex.; and Mena National Park, Ark.

Through the agency of the coordinating committee on national parks and forests, mutually satisfactory boundaries were worked out for the Sequoia, Rocky Mountain, Mount Rainier, Grand Canyon, and Yellowstone National Parks. The new boundaries for the Sequoia and Mount Rainier Parks have been established by acts of Congress, and a partial adjustment of the boundaries of the Rocky Mountain Park has been similarly approved. Bills for the adjustment of the boundaries of the Grand Canyon and Yellowstone Parks are pending before Congress. The proposed additions to the Yosemite and Crater Lake National Parks were studied in the field by the coordinating committee last summer.

The proposed Mena National Park was examined jointly by representatives of the National Park Service and the Forest Service, who recommended against it. The proposed Cliff Cities National Park is still under consideration.

#### NORTHERN PACIFIC LAND-GRANT HEARINGS

The special joint committee of five Senators and five Representatives appointed under House Joint Resolution 183 of June 5, 1924, following the assertion by the Northern Pacific Rail-

way Co. of an alleged right to select 2,600,000 acres of national forest land, valued at approximately \$25,000,000, reconvened on April 14 and held hearings until June 29, 1926, when it adjourned for the summer. The hearings were a continuation of those held by the committee from March 18 to May 20, 1925.

A digest of the reports of the hearings, which contain over 5,000 pages of testimony, is now in course of preparation for the use of the committee when it reconvenes in December. The record seems clearly to support the

contention of the Forest Service that the railroad company has not complied with the terms of the land grants and therefore has no legal or equitable right to acquire the national forest lands it has proposed to select.

#### PROTECTION FROM FIRE

The number, size, and causes of fires on the national forests in the calendar year 1925, as compared with those of the previous year and the average of the past five-year period, are shown in Table 4.

TABLE 4.—Comparison of fires on national forests, calendar years 1925, 1924, and 5-year average for period 1921–1925

Classes and causes of fires	Number of fires			Percentages of total		
	1925	1924	Average 1921–1925	1925	1924	Average 1921–1925
Class of fire:						
Burns less than 0.25 acres.....	4, 531	3, 756	3, 363	54.83	45.54	49.60
Burns between 0.25 and 10 acres.....	2, 264	2, 463	1, 898	27.40	29.87	27.99
Burns 10 acres and over.....	1, 468	2, 028	1, 519	17.77	24.59	22.41
Total.....	8, 263	8, 247	6, 780	100.00	100.00	100.00
Causes of fires:						
Railroads.....	274	397	386	3.32	4.81	5.69
Lightning.....	5, 001	3, 421	2, 850	60.52	41.48	42.04
Incendiarism.....	894	1, 127	881	10.82	13.66	12.99
Brush burning.....	214	309	262	2.59	3.75	3.86
Lumbering.....	150	210	164	1.81	2.55	2.42
Camp fires.....	664	876	1, 804	8.04	10.62	126.61
Smokers.....	843	1, 551	10.20	18.81	126.61	6.39
Miscellaneous.....	223	356	433	2.70	4.32	6.39
Total.....	8, 263	8, 247	6, 780	100.00	100.00	100.00

Calendar year	Total area of national forest land burned over	Total damage of national forest land burned over	Total cost fighting fires exclusive of time of forest officers
1925.....	Acres 251, 102	Dollars 752, 851	Dollars 857, 516
1924.....	602, 044	1, 532, 100	1, 582, 792
5-year average, 1921–1925.....	373, 283	634, 528	755, 641

<sup>1</sup> Includes smokers' fires. Before 1922 camp fires and smokers' fires were classed together.

The number of fires in 1925 was practically the same as in 1924, but the acreage of national forest land burned over was 42 per cent less, the damage to the national forest resources 49.2 per cent less, and the total cost of fighting the fires, exclusive of the time of forest officers, 54 per cent less. There was a large preponderance of lightning fires and a marked reduction in the man-caused. The national forests of California,

Oregon, Washington, Idaho, and Montana had 69.5 per cent of all the fires of the year, and 83.2 per cent of the lightning fires. On these forests lightning caused 72.5 per cent of the fires and all other causes combined only 27.5 per cent. Man-caused fires on all the forests were 1,564 fewer than in 1924, a decrease of 32.4 per cent.

That the losses and costs of suppression were smaller, notwithstanding the virtually equal number of fires, was



largely due to better weather conditions. Early in the season severe drouth caused trouble in the Southwest, and in later months similar conditions were prevalent in Oregon, Washington, northern Idaho, and western Montana. On the eastern forests the fire danger was serious toward the end of the season. Nevertheless, the conditions generally were far more favorable than in 1924 and 1926.

As compared with the five-year period, fires caused by railroads were 29 per cent fewer, by brush burning 18.3 per cent, by lumbering operations 8.5 per cent, by campers and smokers 16.5 per cent, and by miscellaneous or unknown causes 48.5 per cent. Railroad fires were smaller as well as fewer; the companies as a rule diligently seek to prevent fires, and danger spots along their rights of way are being steadily lessened.

Incendiarism continues to be troublesome in isolated parts of the national forest regions, notably in parts of California, and in some of the forests in the southeastern States. Vigilance of patrol in danger seasons and strict law enforcement have done much to counteract the evil.

The vigorous campaign of prevention of campers' and smokers' fires bore fruit in 1925, with 920 fewer fires traceable to these causes than in the previous year, or 37.9 per cent, and 297 fewer than in the five-year period, or 16.4 per cent. In 1925 additional emergency restrictions were imposed by closing dangerous areas to tourists and campers and prohibiting smoking except in inhabited parts of many of the forests. The falling off in the number of these fires represents a considerably greater advance than the figures themselves indicate, for many more people were on the forests.

#### THE FIRE SEASON OF THE SUMMER OF 1926

The 1926 season has been exceptionally difficult. In the Southwest the spring rains were heavier than for several years, and the precipitation was normal in the Rocky Mountain and intermountain regions, but it was considerably below normal in the East, the Lake States, the Black Hills, and the States along the Canadian border and the Pacific coast. A prolonged drought in the early spring and summer resulted in bad fires on the Pisgah National Forest in North Carolina and the Monongahela National Forest in West Virginia, and many fires occurred on private holdings out-

side the forests, some of them causing serious losses. In May and June extensive fires burned on the Allegheny National Forest in Pennsylvania, two of these fires in June covering upward of 20,000 acres. In the Northwest fires started in April, and by the middle of May the season was well under way. Damaging fires occurred in Minnesota and on the Harney National Forest in South Dakota, one fire on the latter forest burning over 12,000 acres.

In May and June the forests in California and the North Pacific States suffered from many fires, and stringent restrictions on campers and smokers were enforced on forests where the danger was great. Early in July dry electrical storms caused a large number of fires in California, 65 on the Sierra National Forest starting from a single storm. By the middle of July the fire-fighting organization was taxed to its utmost in northern Idaho, western Montana, Washington, and Oregon. From July 10 to July 20 the number of fires in Montana and northern Idaho was 413. The Kaniksu and Pend Oreille National Forests suffered most. On July 6 lightning storms set 72 fires on the Kaniksu National Forest alone, and on July 12 upward of 150 fires were again started by lightning on this unit.

At the same time large fires were burning on the northern tier of forests in Washington, and the gravity of the situation was greatly increased by the exhaustion of the local labor supply in the northern Rocky Mountain region. Troops were obtained from Fort Missoula to help fight a large fire on the Blackfeet National Forest in Montana, and from Fort George Wright at Spokane to assist on the Kaniksu National Forest, on the line between Idaho and Washington. At the end of July 3,000 men were fighting the fires in this district, and many forest officers experienced in handling fire crews were drawn from other districts in which the situation was less dangerous. Most unfavorable conditions continued in early August, with the lookout service largely blinded by smoke, the weather exceptionally hot and dry, and high winds fanning the flames and causing a rapid spread of the fires on a number of the forests.

In Washington and Oregon conditions of great severity also prevailed. As in Montana and northern Idaho a scourge of lightning fires descended in July, starting in ten days 319 out of 397 fires. Early in August 37 large fires were burning on 12 forests, and



in the next ten days 183 new fires started, of which 140 were man-caused. At the close of this period 1,000 fire fighters were contending with 45 large fires, on 17 of the 22 forests in the two States.

About the opening of August the situation in California which had been very critical in the northern part of the State, improved somewhat, but soon became alarming again, with high temperatures and low atmospheric humidity. Many fires started on the Klamath, Shasta, Trinity, Plumas, Tahoe, Stanislaus, Sierra, and Sequoia National Forests. The initial spread of the fires was exceptionally rapid, and very large fires also developed on outside lands which had to be fought on an enormous frontage as they approached the national forests. Thousands of acres of national forest lands were burned over, and the losses of private owners were still larger. Happily, the long period of unrelieved drought and hot, windy weather which made the season so severe throughout the Pacific Northwest and northern Rocky Mountain regions was broken immediately after the middle of August by rain, and thereafter the problem of control was free from abnormal difficulties in those regions.

Five of the 21 years since 1905 have been very bad fire years. The first and on the whole the worst year was 1910, when more than 4,000,000 acres of national forest land were burned over. In that year the fire-fighting expenditures were \$1,150,000. In 1919 they were \$3,000,000, but the 6,800 fires burned over only 2,000,000 acres. Preliminary and incomplete figures for the present year place the total cost of fire fighting at \$2,250,000 the number of fires at 6,229, and the area burned at 704,000 acres. In area lost 1926 stands fourth among the five worst years. Yet in one respect at least it outdistanced any other year. It was the worst lightning-fire year ever known.

The unexampled losses of 1910 were due to furious winds which in northern Idaho and western Montana developed into a hurricane. This came late in a very severe and prolonged fire season, when many large fires were burning, the woods were exceedingly dry, and the energies of the Forest Service were already taxed to the uttermost. At that time the service had neither experience in handling emergency conditions nor organization, equipment, and means of communication and transportation necessary to

carry on a difficult and shifting campaign in the heart of great wilderness areas; and a national disaster followed.

In 1919 a season worse than that of 1910 in every respect except the culminating wind attack found the service vastly better prepared to fight the fires. The outstanding characteristic of that season was its extraordinary length combined with its severity. Both the losses and the expenditures were very heavy, but no catastrophe developed; and valuable experience was gained. Each year of such experience has made the defense stronger against the next attack.

But the attack shifts. It came this year in the form of a tremendous and unparalleled bombardment of the forests over a very wide area by dry electrical storms, at a time when the inflammability of the forests was exceptionally high. The result was to overwhelm the protective force at some points. In the main, however, the defense held.

The season, with its early beginning, was for a considerable time of first-class severity as a result of no rain, abnormally dry air and soil, and often strong winds. Such a season means many fires, for they start with the utmost ease; and they spread very rapidly.

The main problem of fire control relates to Forest Service districts 1 (Montana and northern Idaho), 5 (California), and 6 (Oregon and Washington). The five States named contain almost three-fifths of all the timber standing in the United States. All have normally a long summer period of exceedingly light precipitation during which the surface vegetation and forest soil become dry. In all of them the forests are mainly in mountainous regions, which make it hard both to get to fires quickly and to fight them successfully. And in all of them lightning fires are major menace. It is in these districts, in short, that fire control is most crucial and most difficult.

In all three the winter snows were much lighter than usual. In California particularly there was a cumulative deficiency of moisture because of 10 preceding dry years. Everything worked together, therefore, to create high inflammability at the time that the main attack of lightning suddenly broke.

It came between July 1 and July 20. For the most part the storms were unaccompanied by rain. In four

northern California forests 145 lightning fires were started about July 15. In the Washington and Oregon forests 484 lightning fires occurred between July 1 and July 12, mainly if not wholly in consequence of two extraordinarily severe dry electrical storms on July 5-6 and July 11-12. The same storms swept across Montana and northern Idaho.

The forests which suffered worst were those forming the northern fringe; and the Kaniksu National Forest in Idaho was hit hardest of all. The 72 fires started on July 6 were all detected, reached, and brought under control by the local protective forces—guards, smoke chasers, and trail crews. This was a remarkably good record when the demands made upon a limited number of men by so disconcertingly many calls at once are borne in mind. Control of the last of these fires was completed by July 11. Then came the bombardment of July 12—the most severe lightning discharge ever seen in this region. All along the Canadian border, in Montana, Idaho, and Washington fires were set.

The known number on the Kaniksu exceeded 150. Cases were observed in which, within 100 yards of the tree from which the fire spread, 8 or 10 other trees were shattered. One ranger district had 16 fires that night, all of which were promptly reached and put out. But another ranger district had 60. It was impossible to fight all the fires at once. Partly because of low visibility due to smoke, partly because of a place of origin not fully commanded from the lookout stations, some gained headway undiscovered. Later they spread, driving back the forces gathered to hold them, until they swept over the sites of fires that had been subdued; or they united one with another. Of all the fires started, only 32 failed to be brought under control by the local protective organization; but aided by a week of "fire weather"—that is, days of exceptionally low humidity and high winds which on July 18 developed into a gale—these relatively few unsubdued fires became conflagrations. The fight against them necessitated the largest concentrated organization and supply of men, subsistence, tools, and motor-truck and pack-train transportation ever thrown into a single field by the Forest Service.

At the maximum more than 1,400 men were employed. Forty officers were drawn from other forests, and 100 separate camps were established first and last. A total of more than

500 miles of trenches was built. Often laboriously established fire lines were lost because the wind carried high over them burning brands and sparks from which spot fires were started in their rear; sometimes the lines were broken by crown fires in a frontal assault; sometimes they were outflanked. On steep mountain sides ignited material often rolls or drops far down the slopes, starting new blazes as it goes; this was in some cases the reason for the escape of fires started by the lightning storms of July 12, after their control was nearly established.

The battle on the Kaniksu was more than a month long. On the evening of August 16, when only 4 of the 32 great fires were not under full control and safe except in the contingency of extremely heavy winds, rain came.

The Kaniksu has a total area of 444,686 acres of Government-owned land and a gross area of 657,620 acres. The fires covered 110,000 acres of Government land and 44,000 acres of private land within the forest, or not quite one-fourth of the gross area. Though the loss was so great, it was not a barren victory that was already practically won when the rain began to fall on the evening of August 16; for without the long fight against great odds not much of the forest would now be unburned. It must not be forgotten, however, that such fires mean the wiping out of the results of many successful smaller battles of former years, and of the young forest growth on reforesting old burns; nor that a few more battles of the same magnitude on the same forest would leave little to be fought for.

In the results obtained in California the picture brightens. As has already been indicated, the season there was one of unusual severity. The effects of unfavorable weather conditions this year were intensified by the cumulative effects of 11 dry years in succession. With the forests so highly inflammable fires got under way very fast. Frequently the flames covered from 1,000 to 4,000 acres before the first sundown, yet were under control by morning. One fire outside the Sierra National Forest ran over 8,000 acres the first afternoon. All told the outside fires probably covered at least 1,000,000 acres. A single one was reported at 85,000 acres, and another at 65,000. The great difficulty of holding in check such enormous fires as they sweep on toward the forest boundaries is obvious. Nevertheless the



entire area of national forest lands burned over in California was less than 190,000, or a little less than 1 per cent.

Out of 1,362 fires reported, of which 510 were lightning fires, largely bunched, 74 per cent were confined to an area of less than 10 acres. Relatively few fires required protracted campaigns to suppress. Fine cooperation was given by the lumber companies, most of which effectively enforced fire precautions; and there were few serious lumbering fires. A greater degree of public cooperation for fire prevention was given than ever before; and in southern California large contributions from public agencies and other local sources increased materially the degree of protection afforded the forests south of the Tehachapi.

In district 6 (Oregon and Washington) the area of national forests burned over was 121,051 acres, or 0.53 per cent. For all districts the area was 722,810 acres, or 0.46 per cent.

#### AIR PATROL

Airplanes were used in California, Oregon, Washington, northern Idaho, and western Montana. With the exception of some weeks of patrol over the Klamath National Forest in California because of an incendiary outbreak, regular patrol was not carried on but the planes were held in readiness for reconnaissance of large fires, the confirmation of reports of fires concerning which it was difficult to obtain reliable information from other sources, and flights after lightning storms and when the atmosphere was too smoky for the effective detection of fire by observers on the ground. A new use of the planes developed in 1925 was in transporting materials and dropping them where needed on the actual fire lines.

Five bases were used during the season—Mather Field and Glendale Park in California; Eugene in Oregon; and Vancouver and Spokane in Washington. The airplanes were furnished by the Air Service of the Army, and the pilots and mechanics were employed by the Forest Service. With the cooperation of the liaison officer detailed by the Air Service and a number of Air Service officers in charge of reserve officers' squadrons in the Army Ninth Corps Area the pilots were selected from reserve-officer candidates; the mechanics were obtained from a select list of ex-Air Service enlisted men with extensive experience in keeping up the type of planes used.

Officers and employees of the Forest Service acted as observers as necessity arose.

The number of flights made for fire protection, exclusive of test flights, engine-change trips, and transfer of planes, was 429, and the aggregate flying time was 905 hours. This considerable amount of flying was done without accident to personnel, although four of the planes were put out of commission temporarily by forced landings and landings on rough ground.

The Secretary of War has indicated the inability of the War Department to furnish airplanes for the work of fire patrol next year. If this activity is to be continued after the close of the present fire season, apparently arrangements must be made to handle it on a commercial basis. The appropriation for this purpose does not admit of the purchase of the number of machines indispensable to effective patrol, and indeed the Forest Service could not afford to own its own planes for the comparatively short period during which it needs them.

#### PREDICTION AND STUDY OF FOREST FIRE WEATHER

Based upon studies of "forest fire weather," the Weather Bureau has begun predicting the occurrence of dangerous conditions, and last summer provided in the Pacific coast and northern Rocky Mountain regions special warnings of hazardous weather. This fall the service will be extended to the Lake States and Northeast.

The forecasts are sent to all forest agencies, published in the local daily press, and released by radio. They are being carefully followed by timber owners and operators. When critical conditions are indicated patrol forces are increased, additional lookout men are placed at points of vantage, fire crews are held in readiness, and in some cases logging operations are entirely suspended. Many timber operators have installed radio sets at their woods camps so that they may receive these weather predictions with the least possible delay.

Through advance notice of forest-fire weather fewer man-caused fires can be expected, in spite of the increased hazard which attends greater use of the forests. To make its forecasts more accurate and of the greatest possible benefit, the Weather Bureau in cooperation with the Forest Service, State foresters, conservation associations, and other organizations is establishing numerous additional



observation stations. On many logging operations recording hygrothermographs are watched by the rank and file of woods workers with interest. Much of the time and funds of the forest experiment stations is being used to study the factors which contribute to the occurrence and increase the rate of spread of forest fires, the measures necessary to prevent and suppress fires, and the damage that fires do. Studies are under way to determine just how humidity, temperature, wind, and dryness of the forest fuels affect the fire situation. At several of the experiment stations the moisture content of duff is being studied through the use of the duff hygrometer developed at the Forest Products Laboratory. Throughout the entire West the lookouts on the national forests are studying the path and progress of each lightning storm that we may learn how to use the approach of these storms as an indication of the measures called for.

#### OTHER FIRE STUDIES

Similarly the records of thousands of fires are being analyzed each year to discover the causes which lead to catastrophes and to aid in procuring better forest-fire organization and control. These studies supplement the constant and determined pursuit of improved technic of fire fighting, more effective field organization, better preparation of personnel through special training, and every other practical phase of the combat. Year by year the efficiency of the protective system maintained by the Forest Service is being increased. It will never be possible to eliminate fires as a formidable enemy of the forests, nor to reach the point at which in exceptional years major conflagrations may not occur, as they may occur in cities; but the fire problem is being steadily reduced to smaller dimensions through energetic attack upon it from all angles and with all the power that the organization can bring to bear.

#### REQUIREMENTS FOR REDUCING LOSSES

Efficient and economical protection demands preparedness and vigorous effort to cut down the number of fires that start and to detect, reach, and put out those that do start in the shortest possible time. The present provision of funds for fire control does not make for economy. It tends to augment both the final actual expenditures and the property losses suffered by the

Government. When emergency conditions become acute practically unlimited funds become available for fire fighting. The Forest Service is expected to spare no effort to bring bad fires under control. The deficiencies thus created are laid before Congress, which has never failed to relieve the shortage through deficiency appropriations.

On the other hand, the preliminary organization, equipment, and measures necessary to prevent fires, to check them on discovery, and to control them within narrow bounds are limited by specific appropriations which are inadequate. Increase of these appropriations is one of the most imperative needs confronting the Forest Service.

Experience has proved conclusively that fire-fighting expenditures and fire losses can both be materially reduced by measures of prevention and preparedness of the following order:

1. Educational work among local residents directed toward the elimination of specific local causes of man-set fires.

2. A vigorous enforcement of anti-fire laws.

3. The removal of recognized hazards such as road-side slashings and other accumulations of inflammable debris.

4. Various means of "fireproofing" the woods, such as the construction of firebreaks or rudimentary fire lines, which may quickly be widened when fires have to be fought, and the felling of snags or dead trees when they form exceptional hazards or stand along strategic lines of fire control.

5. Adequate fire-suppression equipment of demonstrated merit, such as hand and gas pumps and fire trucks ready for emergency use.

A rapid completion of lookout towers and telephone lines to facilitate the most speedy discovery and initial action on fires.

7. A strengthening of the protective organization through more rangers, fire dispatchers, and patrolmen at points now known to be weak.

The resources available for these common-sense measures of preparedness are now seriously inadequate. The service is throwing into them all the funds that can be pared off from other activities. Its field officers are coping with one critical fire emergency after another with unexcelled loyalty, determination, and physical endurance under most trying conditions. But its efforts to protect the vast public property entrusted to its charge will

never be fully availing until much more liberal provision is made for the basic work of protection needed along the foregoing lines.

### PROTECTION FROM INSECTS

There are some losses from tree-killing insects every year in all coniferous forests. Occasionally the insects become unusually abundant locally, and instead of killing only an occasional weakened tree infest large groups of valuable mature timber. Bark beetle epidemics of this sort have to be met by felling the infested trees and peeling or burning the bark. This prevents the emergence of new broods. Though only a part of the infested trees are reached, any large reduction in the local beetle population gives help to the natural enemies of the pest and tends to reestablish normal conditions.

The fight in previous years against the bark beetles on the Kaibab National Forest in northern Arizona apparently had this effect. The infestation there has subsided, and no work was necessary during the year. Another epidemic on the Lincoln National Forest in New Mexico appears to be breaking up from natural causes, after millions of board feet of pine timber had been killed; but the decline is slower than if funds had been available to combat the infestation. In California, strong colonies of insects are causing considerable loss in valuable pine timber in private ownership near or within several national forests, but during the year actual control work was limited to a small cooperative project in the southern part of the State, where the owners gladly joined in the effort.

The breaking up of the Kaibab infestation made available funds with which to begin work on two serious epidemics in Montana. One of these was in a valuable western white-pine stand on the Kootenai National Forest, about 20 miles from the Canadian border. It is too early to speak confidently of the results of this work, but it is believed that the epidemic was checked. The other Montana infestation was in the lodgepole pine on the Bitterroot and Beaverhead National Forests, on both sides of the continental divide. On the east side of the divide the beetles were establishing strong colonies and killing groups of from 2 to 50 trees in a place. The chief effort of the year was to treat these groups, and so to prevent further loss in the valuable timber on the watershed of the Big Hole River.

On the west side of the divide, on the Bitterroot National Forest, limited funds permitted work on only a small part of the infestation. It is planned to attack the infestation there vigorously in the spring of 1927.

The cordial cooperation of the Bureau of Entomology continued. This cooperation not only included the identification of insects and the giving of advice on the technic of control operations based on the habits and life history of the particular insect involved but also the joint study of insect infestation conditions on a number of national forests. Particularly valuable help was given by the bureau in the effort to lessen the damage from tip moths in the plantations on the Nebraska National Forest.

### TIMBER

The cut of timber exceeded any previous year and totaled the equivalent of 1,192,000,000 board-feet, or 170,000,000 board-feet more than in 1925. It was the third successive year in which the national forests have furnished over 1,000,000,000 feet "for the use and necessities of citizens of the United States." For 20 years the increase in cut has averaged between 8 and 10 per cent annually. Contracts made or pending give ground for the belief that this average will hold for the next 5 or 10 years, though with fluctuations.

As has been urged in previous years, expanding timber sales necessitates a larger force of men competent to handle them if cutting is not to injure the forest and if a sustained yield is to be assured. Expert selection and designation of the part of the stand to be harvested and expert supervision of the cutting operation is essential. Competent scaling of what is cut is likewise essential; the scaling determines the receipts. The making of timber sales is still handicapped by inadequate funds. To handle properly a larger volume of business will require increased provision for meeting the expenditures involved.

The increases in cut are neither an indication nor a product of a commercialized administrative policy. The forests are not being managed primarily to put as much money as possible into the Public Treasury. Receipts are not swollen by offering bargains in stumpage, nor is timber forced on the market regardless of consequences to the trade or possible resulting waste in utilization. On the contrary, the essence of the policy is the largest public advantage.



This is not always clearly understood. The growth of the national forest timber business is sometimes regarded askance. It has been held to menace the orderly utilization of the country's timber supplies and has been attributed to a desire to make the forests self-supporting as soon as possible, without regard to the consequences. To clear up these misapprehensions it seems best to restate the main purposes governing the disposal of timber.

National forests are by law established to "improve and protect the forest, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of the citizens of the United States." Administrative regulation of their occupancy and use is governed by the principle promulgated by the Secretary of Agriculture under authority of the same law, that "all land is to be devoted to its most productive use for the permanent good of the whole people \* \* \* and where conflicting interests must be reconciled the question will always be decided from the standpoint of the greatest good of the greatest number in the long run." Public management of the timber resource and disposal of its products seeks therefore continuity of production, permanence of supplies, and maximum of public benefits.

It follows that a commercialistic policy having in view primarily the balance sheet is impossible. On the other hand, financial considerations can not be ignored. The burden which the forests impose on the taxpayer should be made no heavier than is necessary to fulfill their purposes; they should become self-supporting when this can consistently be brought about; they should be developed in response to public needs; and those who use their products for commercial gain should pay the public a fair market value for what they take from the forests.

Careful appraisals, based on analysis of costs of production and selling value of the product, precede the offering of the timber and assure the receipt of a fair value for the property. Appraisal is prescribed by law. In all sales of more than \$500 worth of stumpage this appraisal is supplemented by advertising for competitive bids. Except for the so-called "cost sales" to homestead settlers and farmers for use on their own places, Congress has itself laid down the policy that requires purchasers to pay the

going market value of all timber sold. But in deciding where to offer stumpage, and in what quantity, the primary consideration is the maintenance of industrial stability, permanent establishments, and permanent and prosperous communities, not volume of cut and larger receipts.

Most sales are made to supply going enterprises. Sawmills and other wood-manufacturing plants, railroads requiring ties, mines needing timbers and lagging, and farmers who must have fencing material for their fields and fuel for their homes are examples. The increasing volume of sales is largely due to the fact that local exhaustion of private timber has compelled existing establishments and industries in many instances to turn to the national forests for continued supplies. To assure full utilization of the present supply along with proper provision for the growth of a new forest crop in its place, purchasers are required to cut in accordance with carefully framed provisions, to use specified methods of logging, to employ safeguards against fire, and to take only marked or designated timber but also to take all that is so marked or designated.

Wherever the amount of timber available and other conditions permit, sales are carefully adjusted to assure continuous and permanent supplies to all existing establishments dependent upon the national forests for their stumpage. In some cases, however, the national forest timber is so intermingled or so combined in natural logging units with privately owned timber that to obtain its economical utilization and market value it must be logged at the same time, even though a subsequent continuous supply adequate to maintain permanently the mill at its present capacity can not be provided. The salvaging of fire-killed or otherwise rapidly deteriorating timber also sometimes necessitates a local cut in excess of what can be obtained as a sustained yield.

In some regions a reduction in the milling capacity to balance the growth of timber is inevitable. In a few cases the establishment of new mills on a permanent basis is desirable as fast as there is a sound economic basis for their development and in these regions sales are encouraged, under reasonable terms. This benefits the communities through pay rolls, better transportation, increased taxable resources, and return to the counties of 25 per cent of the receipts. For example, the availability of national for-



est timber for paper mills in Alaska will result in the establishment of desirable new industries in that Territory. A large sale made a few years ago in eastern Oregon has already brought the extension of a common-carrier railroad to a town which lacked good transportation facilities, and will greatly improve local economic conditions through the presence of a large sawmill. Such cases are not numerous, and each is studied for its business soundness before action is taken. They are part of the general policy of using the resources of the national forests as they are needed to promote permanent prosperity and to meet real needs.

The lumber sawed annually in the United States averages about 35,000,000,000 board-feet. National forest logging operations supply the logs for less than 2 per cent of this lumber production. The national holdings contain the less accessible timber. They offer opportunities for mills to continue in business after their private timber is exhausted, and the public is thus protected against a shortage of timber to the extent that continuous output from the national forests permits. At the same time, the conservative sale policy in effect, including

the careful appraisal of all timber before its sale, gives the private owners of stumpage full opportunity to liquidate their holdings without unfair competition from Government timber. Sales after appraisal and advertisement tend to establish fair prices for private stumpage in regions where previously the owners of small tracts had no basis of comparison in selling their stumpage.

A sale of 193,000,000 board-feet of saw timber on the Modoc National Forest in California was widely advertised and a bid for it received from a company which is just completing its cutting under a contract on another national forest. The advertisement of 68,000,000 board-feet on the Colville National Forest in eastern Washington brought competitive bids from established operators in the region. At the close of the year, 1,750,000 ties on the Bighorn National Forest in Wyoming and 60,000,000 board-feet of saw timber on the Sitgreaves National Forest in Arizona were being advertised. Bids were received in both cases before the advertising period ended.

Tables 5, 6, and 7 summarize the national forest timber business for the calendar year 1925.

TABLE 5.—Quantity and value of timber sold, calendar year 1925

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>			
Alabama.....	68,000		68,000	\$180		\$180
Alaska.....	53,149,000		53,149,000	91,256		91,256
Arizona.....	442,924,000	306,000	443,230,000	1,205,504	\$241	1,205,745
Arkansas.....	5,308,000	116,000	5,424,000	29,159	116	29,275
California.....	229,005,000	2,143,000	231,148,000	533,053	1,252	534,305
Colorado.....	52,529,000	763,000	53,292,000	141,259	691	141,950
Florida.....	2,072,000		2,072,000	10,221		10,221
Idaho.....	195,938,000	3,740,000	199,678,000	561,722	3,469	565,191
Michigan.....	526,000		526,000	744		744
Minnesota.....	10,447,000		10,447,000	31,050		31,050
Montana.....	38,562,000	4,262,000	42,824,000	102,814	4,454	107,268
Nevada.....	1,618,000	200,000	1,818,000	1,745	210	1,955
New Hampshire.....	3,883,000		3,883,000	16,496		16,496
New Mexico.....	14,372,000	1,292,000	15,664,000	30,593	498	31,091
North Carolina.....	15,243,000		15,243,000	99,158		99,158
Oregon.....	385,982,000	2,600,000	388,582,000	788,735	1,509	790,244
Pennsylvania.....	30,000		30,000	430		430
South Dakota.....	17,867,000	783,000	18,650,000	68,923	867	69,790
Tennessee.....	10,340,000	114,000	10,454,000	17,117	140	17,257
Utah.....	13,853,000	874,000	14,727,000	27,731	956	28,687
Virginia.....	9,063,000	13,000	9,076,000	35,923	20	35,943
Washington.....	237,746,000	192,000	237,938,000	567,154	110	567,264
West Virginia.....	1,361,000	5,000	1,366,000	6,583	5	6,588
Wyoming.....	11,191,000	1,051,000	12,242,000	28,058	932	28,990
Total, 1925.....	1,753,077,000	18,454,000	1,771,531,000	4,395,608	15,470	<sup>1</sup> 4,411,078
Total, 1924.....	1,313,510,000	19,744,000	1,333,254,000	3,243,040	17,695	<sup>2</sup> 3,260,735

<sup>1</sup> In addition, minor products not convertible into board feet were sold; value, \$12,146.

<sup>2</sup> In addition, minor products not convertible into board feet were sold; value, \$19,229.

TABLE 6.—Quantity and value of timber cut under sales, calendar year 1925

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>			
Alabama.....	2,000		2,000			
Alaska.....	57,525,000		57,525,000	\$22		\$22
Arizona.....	47,971,000	339,000	48,310,000	99,715		99,715
Arkansas.....	15,217,000	26,000	15,243,000	108,375	\$290	108,665
California.....	238,857,000	1,737,000	240,594,000	109,230	26	109,256
Colorado.....	53,644,000	700,000	54,344,000	697,185	1,009	698,194
Florida.....	1,343,000		1,343,000	148,070	700	148,770
Idaho.....	144,186,000	3,777,000	147,963,000	5,889		5,889
Michigan.....	367,000		367,000	678,561	3,446	682,007
Minnesota.....	6,428,000		6,428,000	458		458
Montana.....	49,363,000	3,511,000	52,874,000	25,331		25,331
Nevada.....	1,474,000	193,000	1,667,000	115,221	3,711	118,932
New Hampshire.....	8,312,000		8,312,000	1,573	192	1,765
New Mexico.....	23,477,000	514,000	23,991,000	44,556		44,556
North Carolina.....	6,186,000		6,186,000	41,421	474	41,895
Oregon.....	226,979,000	2,306,000	229,285,000	20,629		20,629
Pennsylvania.....	770,000		770,000	626,589	1,492	628,081
South Dakota.....	30,442,000	686,000	31,128,000	1,170		1,170
Tennessee.....	7,032,000	42,000	7,074,000	117,315	733	118,048
Utah.....	6,485,000	669,000	7,154,000	15,075	64	15,139
Virginia.....	6,431,000	19,000	6,450,000	11,948	765	12,713
Washington.....	154,910,000	192,000	155,102,000	28,256	34	28,290
West Virginia.....	379,000	8,000	387,000	235,801	124	235,925
Wyoming.....	79,688,000	980,000	80,668,000	932	8	940
Total, 1925.....	1,167,468,000	15,699,000	1,183,167,000	187,641	930	188,571
Total, 1924.....	1,075,509,000	17,769,000	1,093,278,000	3,320,963	13,998	3,334,961
				2,935,823	15,786	2,951,609

<sup>1</sup> In addition, minor products not convertible into board feet were cut; value, \$4,769.

<sup>2</sup> In addition, minor products not convertible into board feet were cut; value, \$14,074.

TABLE 7.—Number of timber sales, classified according to amount of sale, calendar year 1925

State	\$100 or under			\$101 to \$500	\$501 to \$1,000	\$1,001 to \$5,000	Over \$5,000	Total
	Commercial	Cost	Total					
Alabama.....	13		13					13
Alaska.....	270		270	55	17	7	2	351
Arizona.....	913	147	1,060	3	1	3	4	1,071
Arkansas.....	34	41	75			1	2	78
California.....	566	376	942	18	6	16	14	996
Colorado.....	642	165	807	28	2	11	3	851
Florida.....	111		111			1		112
Idaho.....	755	1,093	1,848	29	7	18	10	1,912
Michigan.....	31		31	1				32
Minnesota.....	68		68	3	3	3	3	80
Montana.....	600	981	1,581	31	4	7	4	1,627
Nevada.....	112	75	187	1				188
New Hampshire.....	147		147			2	1	150
New Mexico.....	751	333	1,084	8		7		1,099
North Carolina.....	257		257	9	1	3	2	272
Oregon.....	404	471	875	38	12	4	9	938
Pennsylvania.....				2				2
South Dakota.....	267	122	389	6	4	12	5	416
Tennessee.....	295	44	339	1	2	1		343
Utah.....	293	427	720	7		2	1	730
Virginia.....	323	16	339			5		344
Washington.....	169	57	226	9	4	5	6	250
West Virginia.....	22	3	25	3		1		29
Wyoming.....	222	232	454	8	1	1	1	465
Total, 1925.....	7,265	4,583	11,848	260	64	105	72	12,349
Total, 1924.....	7,525	5,498	13,023	126	61	101	71	13,382

## TIMBER PLANTING

Table 8 shows by States the acreage planted on the national forests in the calendar year 1925.

TABLE 8.—*Planting on national forests by States, calendar year 1925*

State	Area planted
	<i>Acres</i>
Michigan.....	3,311.50
Idaho.....	3,279.00
Washington.....	1,776.00
Nebraska.....	1,105.91
Minnesota.....	894.00
Colorado.....	478.65
Montana.....	342.00
Oregon.....	221.00
North Carolina.....	75.00
California.....	37.00
New Hampshire.....	18.50
West Virginia.....	13.70
Total.....	11,552.26

In addition 4 acres in North Carolina and 9 acres in California were sown, bringing the total area covered by measures of artificial reforestation to 11,565.26 acres. The total area needing artificial reforestation is estimated at 2,000,000 acres.

The contrast between the two totals is in itself more eloquent of the disproportion between the effort to reforest and the area standing idle and destined to stand idle indefinitely unless artificially restocked than any comment can be. Past reports have repeatedly stressed the inadequacy of the reforestation work. Public criticism of the insignificant rate of progress toward restoring denuded lands to productiveness where natural regrowth can not take place within a reasonable period is rising, and is well founded. The Government is failing to do on the public properties expressly devoted to timber production and watershed protection what the plain logic of the general situation calls for as an extensive practice throughout the country.

The outlay so urgently needed to put the national forests where they should be in this matter in reality would be not an expenditure in the ordinary sense, but an investment. The private owner of timberland on whom is urged a measure of public responsibility for so handling his land that it may continue to produce may well ask what particular obligation he is under to invest his own money in this way, if the deforested public

holdings are to be kept idle for decades awaiting the necessary appropriations to give them value. The figures show that at the present rate it would take over 170 years to cover the land now awaiting the planting crews.

In point of fact even this showing of progress is a deception. One year's fires such as swept the West last summer add new areas calling for reforestation more extensive than the gain of a series of years. Further, under its policy of acquisition the Government is increasing the area in need of planting.

During the year the National Forest Reservation Commission approved the purchase of 50,000 acres of land for addition to the Michigan National Forest under the program for the enlargement of the Federal forests in the Lake States contemplated by the Clarke-McNary law. Title to this land is expected to pass to the United States before the end of the present calendar year. Repeated fires have destroyed the tree growth on about half of this land, so that it can be restored to productivity only by planting. The area to be planted on this forest is thus increased from 50,000 acres to about 75,000 acres. As other similar areas are purchased, each will add to the planting task.

In the Lake States planting can be done more cheaply per acre than in any other national forest region; a larger proportion of the trees planted live; and growth is very rapid. The nearness of the region to the center of population assures a strong market for the products. The present annual rate of planting on the Michigan National Forest is from 3,000 to 4,000 acres.

So long as the appropriation for planting remains unchanged, no increase in the scale of operations in Michigan is possible without discontinuing the work already under way in some other forest region, with the attendant losses in nursery equipment and experience in the work; and the reforestation projects which would be abandoned are almost as urgent and promising as in Michigan.

Similarly, the continuation of the purchase program in the Appalachian region and the creation of national forests from military reservations in the eastern United States have put under national forest administration about 100,000 acres of land now unproductive in regions where the de-



velopment of new timber resources is particularly urgent, but with its present resources the Forest Service is unable to cope with the problem of establishing tree crops on bare portions of these areas except on an experimental scale. These eastern forests should be demonstrations of profitable timber growing available to private citizens, municipalities, and States instead of setting a bad example by comprising in part unproductive land. They are capable of growing valuable pine, spruce, and hardwoods such as black walnut, tulip poplar, and oak. Their location in a region from which the virgin forests have been removed and into which lumber is now shipped increasingly from the Pacific coast makes it the more desirable that every acre should be growing as much timber as it can. On the more mountainous of these eastern forests, such as the Monongahela National Forest in West Virginia, the restoration of a forest cover by planting is also necessary for the beneficial effect on stream flow, the prevention of erosion in the mountains, and the safeguarding of water-power developments and navigation.

The increase in the rate of planting in Michigan to at least 6,000 acres annually and on the eastern forests to at least 5,000 acres annually should no longer be delayed.

## RANGE

## GENERAL CONDITIONS

Forage and range conditions during the fiscal year 1926 were generally good. The winter of 1925-26 was mild and the ranges were open to stock nearly the whole season. Hay was plentiful and stock of all kinds came through in first-class shape. The spring was somewhat cold and late in some sections, but except in a few spots in the Northwest the early summer was one of the best for the stockmen in many years. This was especially true of the Southwest.

The earlier years of drought and hardship had cut down the breeding stock and the 1926 range calf crop will probably not average much above 35 to 40 per cent. This means of course a shortage of steers two years from now, a situation which has stiffened prices for cattle of all kinds. The sheep industry reacted slightly from 1925, but lambs and wool brought fairly satisfactory prices. The 1926 lambing season was uniformly fine and the lamb crop unusually large.

## USE OF THE RANGE

Table 9 shows the number of stock grazed on national forest ranges, by States. For purposes of comparison, the total of each class of stock grazed is shown for 1925, 1924, and 1912.

TABLE 9.—Grazing permits issued and number of stock grazed, calendar year 1925

State	Horses, cattle, and swine				Sheep and goats		
	Permits issued	Number of stock grazed			Permits issued	Number of stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama.....	3	68					
Alaska.....	1						
Arizona.....	1,325	251,240	2,909	321	115	273,073	627
Arkansas.....	34	1,006	4	10	2	7	
California.....	2,171	162,785	5,670	270	355	409,730	4,469
Colorado.....	3,473	290,289	6,087		726	895,490	569
Florida.....	19	742		11	2	499	7
Idaho.....	3,163	136,760	9,267		902	1,337,941	88
Montana.....	2,119	131,142	10,112		437	558,320	75
Nebraska.....	30	9,045	389				
Nevada.....	441	61,187	2,587		100	302,861	
New Hampshire.....	24	153	16				
New Mexico.....	1,722	101,335	2,509	129	325	206,326	13,777
North Carolina.....	255	823	28	52	17	133	
Oklahoma.....	67	2,824	613				
Oregon.....	1,401	107,222	5,784	10	432	627,864	183
South Dakota.....	625	23,822	2,211		12	14,158	
Tennessee.....	22	137	2		3	44	
Utah.....	5,255	130,431	4,806	25	1,904	718,075	
Virginia.....	117	1,207	1		5	180	
Washington.....	615	21,602	1,089		137	171,421	
West Virginia.....	36	298	23	18	51	1,412	
Wyoming.....	887	104,824	3,797		310	644,729	
Total 1925.....	23,805	1,538,942	57,904	846	5,835	6,162,263	19,795
Total 1924.....	25,286	1,664,087	58,184	1,560	5,694	6,301,308	29,068
Total 1912.....	21,188	1,403,025	93,343	4,330	5,313	7,467,890	83,849

Since 1918, the peak year of war production, the trend in numbers of stock using the forests has been steadily downward for all classes of stock. The war-emergency conditions were met by admitting more stock than the ranges could permanently carry. Reductions to prevent overgrazing after the war ended, together with the adverse conditions of recent years through which the livestock industry has passed, have lessened the total volume of grazing on the forests from 1918 to 1925 by about one-fourth. The general liquidation in the livestock business has, in the judgment of experts, about reached bottom, and it is believed that the number of stock grazed next year will show a substantial upward trend.

Table 9 shows that in 1912, when the industry was about normal, the ranges carried 98,000 less cattle and horses than in 1925, but 1,373,000 more sheep. Since 1912 a country-wide decline in the number of sheep has taken place. While the number on the national forests has declined, the sheep permittees in 1925 numbered over 500 more than in 1912, and 134 more than in 1924.

The decline in the number of sheep since 1912 has been in the flocks of large owners. The number of persons allowed to graze in excess of 4,000 sheep fell from 290 in 1912 to 254 in 1925, and the total number of sheep permitted these owners fell from over 2,000,000 to less than 1,700,000. At the same time the number of permittees grazing not more than 1,000 head increased from 2,640 to

3,621, and the number of sheep permitted them increased from about 1,115,000 to more than 1,250,000.

Last year the Idaho forests had 1,337,000 sheep on them, and Colorado came second with over 895,000. In cattle Colorado led with over 290,000, Arizona following next with over 251,000 head.

Owing to the general depression in the cattle-raising industry and the recovery of the sheep business many national forest cattle permittees desired to change their herds to sheep. Such requests have been approved wherever possible; but in some instances a shift from cattle to sheep has appeared inadvisable on account of possible injury to reforestation or watershed cover. Furthermore, on ranges used in common by a number of small cattle owners, it is seldom practical to let a single individual graze sheep. Numerous requests of this kind when placed before the local livestock associations resulted in requests to the supervisor not to allow the change.

#### LIVESTOCK LOSSES

The losses of permitted livestock during the calendar year 1925 were materially lessened, in consequence primarily of improved range conditions. Table 10 shows the losses in each of the national forest districts. The total for cattle and horses was less by 1,868, or 4.7 per cent, than in the preceding year, and for sheep and goats less by 29,118, or 18 per cent.

TABLE 10.—*Livestock losses on national forests, 1925*

District	From poisonous plants		From predatory animals, disease, and other causes		Total	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
1.....	202	1,252	720	12,539	922	13,791
2.....	1,921	3,755	1,187	10,611	3,108	14,366
3.....	987	1,483	24,138	7,550	25,125	9,033
4.....	2,478	10,892	2,679	50,555	5,157	61,447
5.....	484	2,333	1,053	9,322	1,537	11,655
6.....	258	2,618	999	14,778	1,257	17,396
7.....			144	16	144	16
Total.....	6,330	22,333	30,920	105,371	37,250	127,704

#### GRAZING ON MUNICIPAL WATERSHEDS

About two and one-half million people, living in over 700 cities or towns in the Western States, obtain their

water supplies from areas within national forests; and in many instances the Forest Service has entered into special agreements with municipalities for the more complete protection of

their domestic supply of water from diminution or contamination. A pronounced public sentiment exists against the grazing of livestock, and especially sheep, on watersheds from which municipal supplies are derived. Sanitary engineers, however, hold that danger of contamination is not from the livestock but from the presence of human beings on the watersheds. The question of contamination by stock was submitted to the Washington State Board of Health by the city of Walla Walla, which draws its water from the mountains above it, within the Umatilla National Forest. The board of health after an investigation advised the city that the removal of all stock would not insure purity, and that filtration was the only practical way to bring this about.

Nevertheless the city appealed to the Forest Service to prohibit all grazing on the area, under the terms of an agreement previously made for the protection of the watershed. The United States Public Health Service, after a full investigation, informed the Forest Service and the city of Walla Walla that the elimination of all stock from the area would not make the water safe, because all human occupation of the land could not be eliminated. "States have not passed laws to prohibit grazing on watersheds," the report states, "because it is generally agreed among sanitarians that diseases are not transmitted by water from animals to man." This decision by the highest authority will be accepted by the Forest Service as settling the general question, although its application will necessarily be governed by local conditions and the terms of outstanding agreements with municipalities.

#### REMISSION OF GRAZING FEES

On December 8, 1925, Congress authorized the remission of grazing fees "during the calendar year 1926 or any part of such calendar year."

Under this authority the waiver of grazing fees in drouth-stricken regions ordered by the Secretary of Agriculture for the second half of 1925, as set forth in last year's report, was extended to cover the first half of 1926. It affected all forests in Arizona and those farthest south in Utah, and all of the forests in New Mexico except the Santa Fe and Carson. The Manzano in the latter State was added to the list of forests on which the fees were waived, because serious conditions as to forage and water had developed. Thus no grazing fees were

charged on the above forests for the entire fiscal year 1926, except on the Manzano, where the waivers applied for the last half of the fiscal year only. In round numbers the remittance for the fiscal year 1926 totaled \$400,000. The sum remitted for the same forests for the last half of the fiscal year 1925 was about \$200,000. By the end of June, 1926, the forage conditions on the southwestern ranges were much better and the financial outlook for the livestock business was so greatly improved as to make unnecessary remission of the fees after September 30 of the current year.

#### STABILITY OF RANGE USE

In last year's report mention was made of the need for seeking stable use of the national forest ranges, of the limitations within which sound public policy requires efforts to promote stability to be confined, of the adoption of the 10-year grazing permit as a measure designed to give greater stability of use and through this to aid in stabilizing the national forest livestock industry generally, and of the pressure from stockmen for much more extreme measures. It was pointed out that the extreme measures advocated by the stockmen, if adopted, would vest in the individuals now using the range permanent rights in the land, would bring to an end effective control of grazing by the Forest Service, and would make impossible adequate protection of other forest resources and public interests in the properties.

Complaints on the part of stockmen against the system of grazing administration were investigated in detail during the latter part of the fiscal year 1925, and the first part of the fiscal year 1926 by a subcommittee of the Senate Committee on Public Lands and Surveys. This investigation was made under a Senate resolution reading in part:

"The Committee on Public Lands and Surveys, or any duly authorized subcommittee thereof, is authorized to investigate all matters relating to the national forests and the public domain and their administration, including grazing lands in the forest reserves and other reservations of lands withdrawn from entry."

Hearings began April 17, 1925, in Washington and were continued at many western points. They were concluded in Washington in March, 1926. They revealed a fairly united demand for legislation from the stockmen heard, along the following lines:



1. A recognition, definition, and protection by law of rights to graze upon national forests on an area basis, the rights to be based upon established priority of grazing use at the time of the enactment of the law.

2. Such rights to be permanent and transferable in full, but their holders to be responsible for willfull damage to the forests.

3. All contested points between the holders of rights and the Government to be subject to court adjudication.

4. The establishment of independent State boards of appeal to pass on decisions of forest officers not satisfactory to permittees. Decision by these boards to be final and not subject to review by the Secretary of Agriculture.

5. The issuance of long-term permits, preferably for not less than 10 years, which should not be subject to alteration during their term.

6. The determination of grazing fees primarily upon the cost of administration, or at least a continuation of the current fees without increase. There was a general protest against the "commercialization" of range use through charging fees comparable to those paid for private range lands.

In the main these demands were inconsistent with the act of Congress creating the national forests and subversive of the policies and practices established by over 20 years of administration. It was obvious, however, that many of the stockmen heard by the committee sincerely believed that as citizens of the United States and residents of the State in which a national forest is located they were entitled to the assured use of a certain portion of the forest for grazing. On the other hand, small owners felt that they were being discriminated against in favor of large owners, whose present privileges should, they felt, be cut down more drastically to make room for farmers and small livestock producers, whom they held to be more dependent on Government range. The large owners, however, complained of the present Forest Service requirements under which gradual reductions to let in small owners are brought about.

With a carrying capacity on national forest ranges that will take care of not over one-third of the livestock in the national forest States, all demands can not be met. If present permittees were to be given exclusive rights of use in perpetuity, new users could come in and small owners could get more pasturage only by buying or

renting rights previously established. The Forest Service has always held it contrary to public policy and to justice to permit the creation of vested individual grazing rights in the national forests. It is convinced that the adequate protection of forest growth, watershed cover, wild life, and the productivity of the ranges themselves require the continuation of grazing only as a **privilege of use**, made as stable as other considerations warrant but still subject to curtailment or adjustment from time to time. The same policy is believed necessary in order to permit the most equitable distribution of grazing privileges on the national forests as the future needs of western agricultural and livestock communities may determine.

No report of findings has as yet been made by the Senate investigating committee, but several bills covering the grazing use of the public domain and the national forests were introduced. One of these received the approval of the Departments of Agriculture and the Interior. Its chief features relating to the national forests were:

Definite legal recognition of grazing as a subordinate use of the national forests.

Provision for the continued regulation of grazing along the same general lines as are at present established.

Requirement that reasonable grazing fees shall be fixed with regard to the stable value of the forage, and also with adequate allowance for the restrictions and duties imposed upon the permittee for the protection of resources of the forest.

Provision for giving permits a contract status to secure the holder against arbitrary reductions in the numbers of stock allowed on the range or other changes not specifically provided for in the contracts.

Contracts to be for a term of 10 years unless a shorter term is requested by the applicant or is determined by the Secretary of Agriculture to be in the public interest.

Preference to be accorded present permittees who own or control adequate ranch property or range improvements dependent for their beneficial utilization upon grazing in the forest.

Provision by the Secretary at the time of making contracts for a redistribution of the grazing privilege to admit new qualified applicants and to promote the economic development of the locality.

Authorization of local grazing boards with a majority of their members selected by the permittees, to co-operate in administering the act and to decide appeals from decisions of forest officers, subject to final review of appealed cases by the Secretary of Agriculture.

The Forest Service believes, in a word, that grazing may properly be recognized by law as a desirable and permanent form of use of the national forests, subordinate to and correlated with their major purposes of timber production and watershed protection. Such a legal recognition will bring certain advantages of assurance and stability to the livestock interests which utilize these resources and should continue to utilize them. At the same time, if adequate provision is made for the administrative control and regulation of grazing, such a course will, it is believed, be in harmony with and in no wise contrary to our accented national policy of conservation.

The first session of the present Congress closed without enactment of any legislation on grazing, but by regulation of the Secretary of Agriculture provision was made for local grazing boards of review made up of stockmen selected by the permittees and one Forest Service official. Decisions of these boards may be reviewed by the Secretary of Agriculture.

Immediately on the issuance of this regulation all permittees were circularized by each forest supervisor urging that the necessary elections be held. In a large number of forests the advisory boards of the livestock associations refused to call the elections, stating that the present procedure for appealing from decisions of local forest officers was satisfactory and no change seemed desirable. To date only one or two such boards have been organized in the 160 national forests. No cases have as yet been before them for action.

Ten-year permits had been in effect for some time previous to the Senate committee hearings. In 1926 over 50 per cent of the permits outstanding are for the 10-year period.

The question of grazing fees has been given a thorough and independent review by Dan D. Casement, whose report is now before the Secretary of Agriculture. The Forest Service is not committed to any particular schedule of fees, but believes that the principle of fair compensation for the value of the forage utilized is an essential part of the entire program of

stabilizing range use, which it is seeking to put into effect.

#### RECREATION AND GAME

The number of people using the national forests for recreation in 1925 was one-third greater than in the preceding year, and five times as great as in 1917. This form of use represents in the aggregate a very large service obtained by the public from its forest properties, as a sort of by-product. The economical and social importance of this by-product is of far too material consequence to be ignored, even though it comes about mainly through free exercise by the people of their right to enter upon the forests as they choose, for all proper and lawful purposes. That right should not be restricted without urgent reason; it should rather be recognized administratively, and its exercise provided for in such ways as are necessary to enhance its value and facilitate its enjoyment. Hence the need for a national forest recreation policy.

That policy rests upon two cardinal principles—the right of the public under the law to use the forests for this purpose, subject to the rules and regulations prescribed by the Secretary of Agriculture, and the duty of the Forest Service to obtain from the forests the largest possible net total of public benefits, or the “greatest good of the greatest number in the long run.” Previous reports have pointed out the problems involved, the general course that is being pursued, and the urgent need for a moderate outlay to lessen the hazards arising from large recreational use. These hazards are of two kinds—hazards to which the public properties are exposed through lack of adequate fire control, and hazard to the public health through unsanitary conditions.

As has been repeatedly pointed out before, the primary requisite to meet this hazard is improved camp grounds, made fire-proof, supplied with pure water, and provided with sanitary toilets and means for garbage disposal. The cost of such improvements is relatively small. The appropriation for this purpose was \$40,000 as against \$25,000 for the fiscal year 1925. The Forest Service also received many co-operative contributions of funds, materials, and services for the same purpose. All told, 148 additional camp grounds were at least partially equipped during the year, increasing the number to 599.



There remains a shortage of very necessary facilities upon approximately 1,000 heavily used areas. The Federal Government should not allow its immunity from local sanitary regulations to partially nullify State laws and thus relieve it from compliance with the requirements to which private landowners are subject for the protection of the public health. Immediate improvement of enough camping places to accommodate the present public use would cost approximately \$250,000. In comparison with the protection that would be afforded the public properties and the health of large numbers of people who congregate on small areas without proper facilities the outlay involved is trifling.

For some years the Forest Service has cooperated with State health authorities for the determination and enforcement of necessary sanitary precautions. The cooperation of the United States Public Health Service has also been obtained. Study by a member of that organization of the sanitary requirements in the national forests of the southern Appalachian region is under way. The United States Public Health Service feels that specific sanitary problems which are purely intrastate in character should be worked out in cooperation with the State health authorities, but its cooperation will greatly aid the Forest Service in determining the fundamental requirements.

One consequence of the increasingly intensive use of the national forests for recreation is a growing sentiment in favor of the preservation of wilderness areas; that is, areas maintained as nearly in a state of nature and as free from highways, summer-home communities, resorts, and forms of industrial occupancy and use as the minimum requirements of national forest protection and management will permit. The Forest Service is sympathetic with the general conception of preserving within the national forests a number of areas especially adapted to the wilderness form of recreational use and wild-life propagation. The idea has merit and deserves careful study, but its correlation with the other obligations and requirements of national forest administration must be carefully worked out before definite steps are taken to give any areas a wilderness status. It is inapplicable where the limitation of road construction and other forms of development or utilization of forest resources would be unjust to dependent local communities or to the States. No gen-

eral policy can be applied; specific situations must be weighed individually, considering in each case the relative values involved and the general obligation to protect and administer the national forests in ways yielding the largest net results in public welfare.

In working out this policy it must be recognized that certain forms of economic use, such as the moderate grazing of livestock or water storage that does not materially change natural conditions, may not necessarily interfere with maintaining the wilderness aspect of a region as far as it relates to modes of transportation and forms of recreational use. The same applies to the harvesting of mature timber under proper regulations and an assured continuity of forest cover. The "wilderness" idea, as applied to national forests, will be greatly promoted if in its application to individual areas reasonable flexibility is allowed in providing for really urgent needs of the State or local communities.

Annual estimates are made of the amount of game on each forest. That of December 30, 1925, showed a continued upward trend in the numbers of deer and elk. The total for deer was 10 per cent greater than in 1924 and for elk nearly 20 per cent greater. Of the more than 600,000 deer 227,000 are on the national forests of California, while Arizona, Oregon, and Idaho have more than 50,000 each.

The two greatest herds of elk are in the Yellowstone region. From their respective locations they are known as the northern or park herd, and the southern or Jackson Hole herd. Both are in a perilous situation.

The Jackson Hole herd was first counted by forest officers in 1916. It then numbered over 20,000. An unusually hard winter in 1919-1920 left only 9,320. At the close of 1925 the number had risen to over 25,000. The calf crop for the spring of 1926 is estimated at about 6,000 head, so that approximately 30,000 animals will enter the winter of 1926-27.

As has been repeatedly pointed out in previous reports, the limiting factor on both the Yellowstone elk herds is winter feed. Deep snows in the mountains force the animals down the valleys, where ranchers and grazing of domestic livestock on private and open public range lands have severely curtailed their natural food supply. The larger the herds the greater the danger of heavy losses from starvation in hard seasons.



For a number of years, to supplement the forage purchased by the game commission of Wyoming, the Biological Survey has maintained a hay ranch at Jackson to provide hay for the elk in years of need. To enlarge this ranch the Izaak Walton League undertook to buy additional land. My report of last year specified as available for purchase 4,900 acres. Of this the Izaak Walton League has acquired 1,760 acres. There is no present prospect of further purchases.

The situation still leaves the Government without assured means of maintaining the southern elk herd at its present size. In fact, it is doubtful if all the forage resources locally available could carry the present numbers of elk through a severe winter. And the yearly increase in numbers is bound to continue in favorable seasons. The logical procedure is to fix the maximum size the herd should reach, based on the available winter range supplemented in severe winters by the hay available, and then annually dispose of the surplus. Otherwise another winter will come like those of 1910-11 and 1919-20, when the elk starved by thousands. In 1919-20 the Biological Survey expended \$36,000 and the State of Wyoming \$35,000 for hay to save the elk in this herd, but with limited success, as the count in the year following proved.

Such a method or lack of method of game management is deplorable, and an unnecessary waste of a natural resource. The Forest Service is anxious to cooperate with other agencies to end this unfortunate situation. A carefully designed plan, calculated to hold the elk herd at stable numbers through good years and bad by removing all or a portion of the natural increase is needed. An increase in the number of elk allowed each hunter, a somewhat longer hunting season, and possibly a lower fee for nonresident hunters are among the remedial measures called for. These are matters fixed by the Wyoming game laws.

A similar condition exists with the northern or park herd, and to a certain extent with the third largest herd of Rocky Mountain elk, known as the "Sun River" herd, in the Lewis and Clark National Forest of central Montana. For the northern Yellowstone herd the most pressing need is the acquisition by the Government of certain lands lying in a comparatively

narrow strip along the Yellowstone River, just north of the park, as winter elk range. An act approved May 26, 1926, places this strip within the Gallatin and Absaroka National Forests, authorizes the Secretary of the Interior to accept donations of lands within the area, or of funds for their purchase, and also authorizes acquisition of private holdings through exchanges of national forest land or timber elsewhere in Montana. Steps are now being taken to work out a plan of acquisition whereby the lands necessary for the elk will be acquired, partly through private donation and partly through exchanges.

Here again the most fundamental matter is to determine how large an elk herd can be sustained with the forage resources available. Even though the winter range is extended and reserved for the use of the elk, the herd should be held at a number safely within the capacity of the range. Systematic utilization of the surplus above the established limit should be provided for instead of letting the elk multiply, only to die in large numbers through starvation.

The Sun River herd in central Montana has increased to the limit of the available range. In 1910 this herd numbered less than 300. In 1925 it contained over 3,500 and the increase during the spring of 1926 was very large. Fortunately in 1924 the Montana Legislature lengthened the open season on elk from 10 to 30 days, which considerably increased the numbers removed by hunters in the fall of 1925. Nevertheless, there is still an annual net increase of about 10 per cent. The range is now carrying every elk it can without overgrazing, and enlargement of the game preserve is impracticable.

The future management of these three large elk herds on sound lines is being sought through correlated State and Federal effort, based on an accepted common policy. The first essential is determination of the size at which each herd shall be maintained. This involves a decision as to how far domestic livestock production should be restricted to allow place and forage for elk. The next step necessary is to bring into balance the natural increase of the herds and the factors making for their diminution, in some less violent, catastrophic, unintelligent, and unhumane way than periodic widespread starvation. In

the main this means careful adjustment of hunting to keep the utilization equal to the natural but somewhat fluctuating increment, so that the herds may neither be unduly cut down nor enlarged beyond the carrying capacity of the land.

The Federal Government owns most of the land on which the elk feed, and the States through their game laws regulate the utilization of the product. The Forest Service has sought and will continue to seek, a solution of such game problems, as they arise, on the basis of cooperation with the State game departments.

In Arizona a somewhat similar situation has been created by the increase of deer on the Kaibab National Forest, which was made a Federal game preserve by act of Congress in 1906. Authority was conferred at that time upon the Department of Agriculture to regulate the taking or killing of game animals. Legal steps have appeared necessary to determine the scope of the Secretary's jurisdiction under the law, through an application for an injunction to prevent interference by the State with the killing and removal of deer under Federal permit.

Previous reports have set forth the salient facts regarding the seriousness of the situation. Efforts to obtain the consent of the State game authorities to an increased bag limit and reduced cost of hunting license to nonresidents so as to encourage more hunters to visit the region have been unsuccessful. The summer of 1926 has resulted in a fine fawn crop and the deer will go into the winter of 1926-27 with a large increase in numbers to take their chances of survival on a range already overcrowded with deer and depleted of forage. In Pennsylvania a somewhat similar situation was met promptly by State game authorities through the creation of a special open season in addition to the regular deer season, allowing the killing of both sexes, free license to landowners, and a special fee of but \$2 to all others. It was estimated that this would result in the removal of about 3,500 animals, which would reduce the deer to reasonable numbers. Similar action by the Arizona authorities would

avert a probable heavy loss by starvation in the near future.

The mule deer of the Kaibab, numbering probably 30,000 animals, comprise one of the most distinctive and valuable herds of wild life in the United States. It should always be preserved as an outstanding feature and resource of this region. But its preservation from the inroads of sudden starvation can not be assured unless a rational plan for holding the herd down to what its ranges will support is speedily put into effect.

Hitherto no estimates of the number of beaver on the national forests have been published. The reports for 1925 show over 114,000, exclusive of Alaska. Probably half as many more are outside the national forests. Under present methods of protection the beaver are increasing markedly.

The value of the beaver is not only as a fur producer. Their effect upon irrigation can not be overlooked. During recent serious droughts in Colorado farmers, by opening beaver dams in the mountains, poured millions of gallons of water down the stream beds and out through the irrigating ditches upon their thirsty lands. On one stream in Colorado crops valued at over \$15,000 were thus saved. The States are obtaining a very satisfactory revenue from the pelts taken by licensed trappers, who capture the surplus animals when the fur is in prime condition. Under proper regulation excellent returns can be obtained permanently without decreasing the supply.

Table 11 shows in detail the estimated number of big-game animals on the national forests in each State at the close of the calendar year 1925, exclusive of buffalo, of which there were 181 on the Wichita National Forest in Oklahoma and 2 on the Pisgah National Forest in North Carolina. The number of black or brown bear, deer, elk, and moose all show increases in comparison with last year's figures. A large apparent increase in the number of antelope resulted from a count on a different basis from that of previous years, when antelope not occupying the forests for the major part of the year were left out of the tally.

TABLE 11.—*Big-game animals and beaver on national forests—estimates as of December 31, 1925—summary by States*

State	Antelope	Bear		Caribou	Deer	Elk	Moose	Mountain goats	Mountain sheep	Beaver
		Black or brown	Grizzly							
Alaska.....		<sup>1</sup> 5,600	<sup>1</sup> 4,900		<sup>1</sup> 50,300		<sup>1</sup> 545	<sup>1</sup> 9,000	<sup>1</sup> 400	(?)
Alabama.....					67					
Arizona.....	1,809	1,233	29		49,638	797			120	185
Arkansas.....					670					
California.....	394	10,833			227,145	156			968	271
Colorado.....	70	2,783	25		23,390	7,358			4,318	47,314
Florida.....					110					
Idaho.....	1,495	5,238	99	68	52,639	5,900	673	3,136	1,135	12,208
Michigan.....		15			95					
Minnesota.....		710		3	3,785		1,010			2,708
Montana.....	470	5,120	436	20	48,024	9,816	1,140	3,700	1,748	15,383
Nebraska.....					50					
New Hampshire.....					7,000					180
New Mexico.....	711	660	22		20,009	76			150	
Nevada.....	165	44			4,355				115	662
North Carolina.....		55			2,750	25				
Oklahoma.....	16				100	250				
Oregon.....	31	5,593	2		58,869	3,689			43	5,849
Pennsylvania.....		120			1,455	10				
South Dakota.....	2				2,280	717				2,176
Tennessee.....		6			36					
Utah.....	15	393			18,421	1,564			270	9,687
Virginia.....		300			35	60				
Washington.....		5,923	20	52	24,740	8,430		2,051	39	11,138
West Virginia.....		60			30					
Wyoming.....	2,390	1,600	60		9,971	33,317	2,693		2,746	6,563
Total.....	7,568	46,286	5,593	143	605,964	72,165	6,061	17,887	12,052	114,324

<sup>1</sup> 1924 figures for Alaska.<sup>2</sup> No report.**WATER POWER**

The status of water-power permits on June 30, 1926, as granted by the Department of Agriculture under the provisions of the acts of February 15, 1901, February 1, 1905, and March 4, 1911, remained substantially unchanged. The number of transmission-line permits in force at the close of the year was 1 greater than a year previously, the number of power-project permits 6 less, and the number of completed power projects 5 greater.

Under the standing cooperative arrangement with the Federal Power Commission for administering the Federal water power act, the Forest Service was asked to make engineering reports in 56 cases and to super-

vise and inspect the operation of 37 permittees or licensees. Of 102 applications for permits or licenses received by the commission during the year, 35 involved use of national forest land. In all the commission has received 726 such applications, of which 273 involved the national forests.

**ROADS AND TRAILS**

Table 12 gives the accomplishments in and expenditures for road and trail construction and maintenance. The apportionment of road funds among the States for the fiscal year 1927, the total appropriations and authorizations, and the condition of these road appropriations on June 30, 1926, are shown in Tables 13 and 14.



TABLE 12.—*Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds, by States, June 30, 1926*

State	Fiscal year 1926				Total constructed to June 30, 1926		Expenditures to June 30, 1926		
	Constructed		Maintained				Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
	Miles	Miles	Miles	Miles	Miles	Miles			
Alabama-----	6.5		6.0		6.5		\$30,348.77	\$1,982.65	\$32,331.42
Alaska-----	19.4	33.5	166.8	243.3	163.4	243.3	2,560,069.33	197,775.37	2,757,844.70
Arizona-----	228.9	143.2	730.2	781.0	746.6	1,435.2	3,158,943.06	783,714.95	3,942,658.01
Arkansas-----	55.0	39.0	102.9	258.2	279.8	449.1	666,010.09	24,647.73	690,657.82
California-----	234.2	209.2	1,889.7	4,514.8	1,162.1	2,168.1	7,846,839.88	2,756,090.97	10,602,930.85
Colorado-----	169.6	580.3	648.2	4,648.0	973.5	2,590.3	3,951,981.08	703,179.30	4,655,160.38
Florida-----	18.4		78.6	36.5	110.1		204,405.65	110,400.71	314,806.36
Georgia-----	6.0		19.0	168.6	19.5	168.6	199,844.17	39,000.00	238,844.17
Idaho-----	137.2	757.2	1,303.1	7,620.5	1,528.0	5,032.9	7,718,303.97	1,314,381.47	9,032,685.44
Kansas-----					3.4		2,111.51		2,111.51
Maine-----		5.5	5.0	40.8	5.0	40.8	24,350.99		24,350.99
Michigan-----	2.0		90.0		42.4		12,409.83	393.45	12,803.28
Minnesota-----	48.9	11.0	120.5	300.0	230.4	84.7	348,156.43	198,967.98	547,124.41
Montana-----	147.7	526.7	892.5	6,422.0	785.1	2,219.3	4,990,107.08	527,457.82	5,517,564.90
Nebraska-----	6.4		27.5		41.3		48,901.08		48,901.08
Nevada-----	19.2	57.0	307.8	400.9	385.7	751.5	909,708.08	120,212.41	1,029,920.49
New Hampshire-----	3.3	11.8	40.1	284.6	32.5	296.4	145,338.34	5,765.17	151,103.51
New Mexico-----	93.9	63.5	401.2	997.5	516.4	1,245.8	2,528,481.52	235,304.44	2,763,785.96
North Carolina-----	65.2	23.0	106.1	542.3	124.7	565.3	438,829.94	47,620.63	486,450.57
North Dakota-----					1.0		57.75		57.75
Oklahoma-----	5	1	33.3		24.5	16.5	42,256.67	8,475.11	50,731.78
Oregon-----	258.5	701.8	2,482.2	5,745.5	1,863.3	2,412.8	7,463,209.56	4,667,587.40	12,130,796.96
Pennsylvania-----	8.0		27.0	50.0	34.0		23,698.97	1,005.00	24,703.97
Porto Rico-----		6.0		30.3		36.3	11,003.74		11,003.74
South Carolina-----			19.3		16.3	4.0	64,027.66	14,074.45	78,102.11
South Dakota-----	28.3	13.4	170.6	16.7	219.1	43.0	506,393.34	170,891.01	677,284.35
Tennessee-----	35.9	19.5	14.8	413.1	78.3	436.1	198,400.28	103,171.17	301,571.45
Utah-----	83.2	338.8	785.5	1,474.5	890.7	2,407.8	2,284,608.17	683,637.84	2,968,246.01
Virginia-----	41.3	53.4	96.0	500.3	101.3	696.8	340,279.27	15,232.88	355,512.15
Washington-----	139.8	526.0	144.3	5,364.0	675.5	1,727.6	4,825,490.94	1,360,194.06	6,185,685.00
West Virginia-----	14.5	160.8	17.7	228.5	33.2	340.6	61,581.01	1,578.29	63,159.30
Wyoming-----	58.7	410.0	639.1	3,837.0	788.6	1,359.9	2,695,365.37	326,219.55	3,021,584.92
Total-----	1,930.5	4,693.7	11,965.0	44,918.9	11,882.2	26,777.7	54,301,513.53	14,418,961.81	68,720,475.34

TABLE 13.—*Distribution among the States of the total appropriation and of the apportionment for the fiscal year 1927*

State	10-per cent fund		Section 8 fund, total	Federal forest road construction fund, total
	Fiscal year 1927	Total		
Alabama-----	\$38.14	\$526.50	\$15,456.04	\$1,922.31
Alaska-----	11,334.76	116,403.19	466,132.50	192,435.28
Arizona-----	11,670.59	477,591.58	601,167.28	455,986.96
Arkansas-----	9,444.32	78,051.33	174,939.40	129,640.85
California-----	128,056.16	958,840.23	1,450,510.39	1,198,962.84
Colorado-----	41,178.92	511,162.03	755,854.39	777,835.24
Florida-----	2,951.90	25,532.19	119,528.14	22,001.25
Georgia-----	1,016.67	6,209.98	50,964.29	134,390.54
Idaho-----	78,126.33	660,046.58	1,190,614.66	1,357,953.20
Kansas-----		1,867.27		
Kentucky-----	166.10	166.10		
Maine-----	240.83	1,788.18	32.41	3,738.77
Michigan-----	78.45	944.20	7.00	3,000.00
Minnesota-----	4,923.97	24,155.45	7,707.98	108,190.85
Montana-----	23,238.44	472,526.25	741,920.25	731,197.23
Nebraska-----	817.18	14,502.38	18.98	
Nevada-----	9,530.84	129,914.80	194,190.47	82,320.99
New Hampshire-----	3,053.78	22,798.38	341.66	10,857.64
New Jersey-----	15.32	15.32		
New Mexico-----	7,183.79	285,475.08	427,989.45	509,744.74
North Carolina-----	1,743.50	24,283.51	84,556.16	176,501.15
North Dakota-----		45.75	7.00	
Oklahoma-----	834.32	7,242.75	65.49	2,775.17
Oregon-----	77,715.11	658,910.30	1,416,487.23	1,076,735.13
Pennsylvania-----	187.38	293.38	24.04	21.42
Porto Rico-----		3.70	7.00	3,343.09

TABLE 13.—*Distribution among the States of the total appropriation and of the apportionment for the fiscal year 1927—Continued*

State	10-per cent fund *		Section 8 fund, total	Federal forest road construction fund, total
	Fiscal year 1927	Total		
South Carolina.....	\$238.33	\$904.62	\$402.10	\$48,150.05
South Dakota.....	11,642.31	112,410.19	83,167.35	79,674.98
Tennessee.....	1,564.91	12,971.40	78,254.74	28,154.47
Utah.....	15,347.01	302,004.88	443,998.19	465,492.11
Virginia.....	3,812.94	25,472.00	61,009.95	71,355.58
Washington.....	40,443.84	362,227.42	936,313.70	714,038.70
West Virginia.....	501.52	2,905.80	9,921.47	5,049.24
Wyoming.....	27,111.72	304,347.20	460,882.72	548,628.45
Undistributed.....			227,527.57	59,901.77
Grand total.....	514,209.38	5,602,539.92	10,000,000.00	9,000,000.00

State	Forest highway fund		Forest development fund		Grand total
	Fiscal year 1927, appropriated and authorized	Total	Fiscal year 1927, appropriated and authorized	Total	
Alabama.....	\$3,886.00	\$16,169.00	\$6,406.00	\$25,297.00	\$59,370.85
Alaska.....	473,844.00	2,629,512.00	19,009.00	135,776.00	3,540,258.97
Arizona.....	278,446.00	1,589,585.00	90,615.00	777,522.00	3,901,852.82
Arkansas.....	33,836.00	188,881.00	47,975.00	247,102.00	818,614.58
California.....	681,222.00	3,891,888.00	408,164.00	2,216,566.00	9,716,767.46
Colorado.....	335,972.00	1,916,939.00	166,534.00	1,000,664.00	4,962,454.66
Florida.....	12,098.00	63,859.00	21,861.00	57,684.00	288,604.58
Georgia.....	11,063.00	45,155.00	20,112.00	77,946.00	314,665.81
Idaho.....	510,637.00	2,914,252.00	631,776.00	3,519,636.00	9,642,502.44
Illinois.....	391.00	391.00	190.00	190.00	581.00
Kansas.....					1,867.27
Kentucky.....	1,610.00	1,610.00	3,232.00	3,232.00	5,008.10
Maine.....	1,262.00	7,263.00	578.00	10,650.00	23,472.36
Maryland.....	352.00	352.00			352.00
Michigan.....	2,392.00	12,039.00	11,158.00	42,729.00	58,719.20
Minnesota.....	29,376.00	168,277.00	65,573.00	237,776.00	546,107.28
Montana.....	403,872.00	2,321,035.00	289,443.00	1,973,685.00	6,240,363.73
Nebraska.....	4,675.00	28,870.00	1,312.00	24,474.00	67,865.36
Nevada.....	96,939.00	553,886.00	5,229.00	94,374.00	1,054,686.26
New Hampshire.....	16,115.00	92,455.00	13,557.00	78,858.00	205,310.68
New Jersey.....	837.00	837.00	380.00	380.00	1,232.32
New Mexico.....	211,035.00	1,211,959.00	135,030.00	617,376.00	3,052,544.27
New York.....	706.00	706.00	456.00	456.00	1,162.00
North Carolina.....	13,785.00	75,954.00	29,366.00	155,319.00	516,613.82
North Dakota.....					52.75
Oklahoma.....	2,113.00	14,185.00	346.00	21,596.00	45,864.41
Oregon.....	580,591.00	3,225,933.00	516,486.00	2,574,614.00	8,952,679.66
Pennsylvania.....	3,437.00	10,269.00	8,532.00	37,017.00	47,624.84
Porto Rico.....	599.00	3,759.00	290.00	11,255.00	18,367.79
South Carolina.....	1,895.00	6,255.00	4,990.00	28,740.00	84,451.77
South Dakota.....	35,343.00	203,254.00	19,276.00	132,183.00	610,689.52
Tennessee.....	9,951.00	54,970.00	18,519.00	86,100.00	260,450.61
Utah.....	172,530.00	987,504.00	67,079.00	412,065.00	2,611,064.18
Virginia.....	16,093.00	79,055.00	25,144.00	150,457.00	387,349.53
Washington.....	326,755.00	1,883,310.00	250,415.00	1,973,410.00	5,869,299.82
West Virginia.....	4,923.00	23,214.00	17,954.00	61,586.00	102,676.51
Wyoming.....	221,419.00	1,276,418.00	103,013.00	713,285.00	3,303,561.37
Undistributed.....					287,429.34
Grand total.....	4,500,000.00	25,500,000.00	3,000,000.00	17,500,000.00	67,602,539.92

TABLE 14.—*Condition of road appropriations on June 30, 1926*

Fund	Total appropriations to June 30, 1926	Total expenditures	Unexpended balance
10 per cent.....	\$5,088,330.54	\$4,759,372.01	\$328,958.53
Section 8.....	10,000,000.00	8,819,680.40	1,180,319.60
Federal forest road construction.....	9,000,000.00	8,876,468.00	123,532.00
Forest highways.....	21,000,000.00	17,899,133.14	3,100,866.86
Forest road development.....	14,500,000.00	12,678,751.91	1,821,248.09
Total.....	59,588,330.54	53,033,405.46	6,554,925.08

The amount of forest highway and forest development funds as actually appropriated for each fiscal year is shown below:

Fiscal year	Forest highway fund	Forest development fund
1922-----	\$2,500,000	\$2,500,000
1923-----	7,000,000	3,000,000
1924-----	3,500,000	3,000,000
1925-----	3,500,000	3,000,000
1926-----	4,500,000	3,000,000

The development of forest highways in Alaska requires a somewhat different policy from that in the States. In the latter immediate economic requirements or demands for public travel are the main consideration. In Alaska, it is incumbent upon the Government to recognize the needs of a frontier region, all but a negligible portion of whose land is in Federal ownership. Alaska contains enormous undeveloped economic resources, and a constructive policy toward the Territory and its future requires a liberal construction of transportation facilities to promote the comfort and permanency of the present population, to extend settlement, and to encourage the exploration and development of minerals, timber, and fisheries.

It is necessary to look ahead, anticipate the probable development of the natural resources, and provide for the needs of a new country and a growing population. Means of access must be provided for the extension of the pulp and paper industry, the development of prospective mining districts, and new fishing plants and settlements. Roads are prerequisites for such projects and should be built in advance. The forest highway system as now established and the construction programs approved recognize this condition. The Federal highway act of 1921 and the current authorizations thereunder doubtless make available more funds than are needed immediately to construct the roads required under present conditions in the national forests of Alaska. The construction programs approved from year to year, however, are not designed to expend all the funds available but only to take up such projects as are justified under the general policy indicated above.

#### MAPS AND SURVEYS

During the year 30 ¼-inch maps and 23 ½-inch maps covering 38 na-

tional forests, were printed. These maps were compiled and drafted by the Forest Service from data obtained from other Federal organizations, from local agencies, and from Forest Service surveys. In addition, 4,000 atlas sheets, covering eight folio pages of one forest, drawn on a scale of 1 inch to the mile, were issued.

Approximately 1,500 square miles of virgin forest land in Idaho and Washington were mapped on a drainage basis. The control for these surveys was executed to the standard prescribed by the Federal Board of Surveys and Maps.

In the State of Montana a cooperative survey project was initiated with the General Land Office whereby a standard topographic survey of each township is made at the time of the regular subdivisional surveys. This has proved very successful and has produced a map of high standard at a very low cost.

Numerous small projects involving timber, grazing, and land-exchange areas were topographically surveyed.

After the passage of the Temple Act, in February, 1925, it was hoped that considerable progress would be made in mapping the national forests. The bill authorized but did not appropriate funds. Subsequent appropriations by Congress have been insufficient to permit of any new mapping of Federal projects other than those on which State cooperation is obtainable. This has excluded all new national forest projects. It is estimated that 46 per cent of the area of the national forests has been topographically surveyed to a standard which is at present satisfactory. The remaining 54 per cent, or approximately 99,000,000 acres, is in need of accurate topographic surveys. Topographic maps of the forests constitute an essential administrative tool in connection with plan-wise development and satisfactory utilization of resources, and efficient protection, and some way for making more rapid progress in obtaining these maps is an urgent need.

#### RESEARCH

##### FOREST EXPERIMENT STATIONS

To grow an adequate supply of forest products is going to be far more difficult than is generally realized. By far the greater part of the original timber area has been burned or cut over; much of it is unproductive; and a still greater part is only partially productive. Forest land, approximately one-fourth of the total land area of the country, is subject to



many kinds of climate, presents innumerable variations in soils, and has the widest physiographic and topographic differences. These complex physical conditions are matched by the variety and complexity of the natural forest growth.

The forests of the United States contain over 100 tree species of present commercial importance, and over 200 less important species, to say nothing of other forms of vegetation. Each has its own requirements and characteristics. The forest crop must be produced, if it is to be anything better than a wild land yield, through careful control of natural plant associations and competitions.

There are also the effects of insect pests, tree diseases, and livestock, and many relationships between the forest and native animal life. To raise sufficient timber in time to meet the national needs calls for accurate and thorough knowledge along many lines.

At first by the costly, time-consuming, trial-and-error method, and later by systematic research, scientific agriculture has been developed. Experience has shown that experiment stations have been the cheapest and most effective means of determining crop-production methods. A similar task lies ahead for forest experiment stations. In 1921 the Department of Agriculture announced its plan to establish experiment stations in each of the important timber-growing regions, dividing the country into geographic units where the forest conditions and forest problems were similar or related.

An excellent start has been made. Four stations have been established in the East and two in the West, with two more or less local field stations—one in the central Rocky Mountain region and one in the Southwest—where forest investigations are proceeding on an exceedingly meager basis. The larger stations are concerned respectively with the forest problems of the northern Rocky Mountain regions, the Pacific Northwest, the Northeast, the Lake States, the Appalachian region, and the South. During the year Congress provided funds for a seventh station, to be located in California. Its organization will permit beginning work upon the exceptionally diverse problems of California and western Nevada—one of the principal sources of the present lumber cut, and a region where forest lands can be made highly productive.

The recognized need for more forest research in the East led Congress to

authorize an appropriation for two additional stations, one for the Middle Atlantic States and one for the Ohio-Mississippi Valley region. The first station will, when established, serve the States of Maryland, Delaware, Pennsylvania, and New Jersey. This section should be nearly self-sustaining in timber. It now imports 90 per cent of the sawed lumber it consumes and pays for freight annually some \$35,000,000. The Ohio-Mississippi Valley station will serve Ohio, Indiana, Illinois, Iowa, Missouri, and the western portion of Kentucky and Tennessee. In these States are some 40,000,000 acres of forest land. Upon the rough, broken, or overflow lands unsuited to farming timber growing can be made an integral part of diversified agriculture. Determination of the forestry practices applicable to the farm wood lot is of major importance in this region. The high-grade native hardwoods constitute a resource of special value.

At least one additional station is needed in the American tropical possessions of the West Indies and the Canal Zone to round out the general program. Practically nothing is known of timber production methods in the American Tropics. The forest growth rate is exceedingly rapid. These forests can very probably produce on American soil such necessary products as camphor, rubber, tannin, and cork, as well as woods not grown in the continental United States.

To meet within a reasonable time the urgent problems awaiting solution by the forest experiment stations is beyond their present personnel and equipment. The Northeastern Forest Experiment Station has taken up only a few of the many important problems of the spruce forests of New England and New York, and has had to leave out for the present the problems of the mixed hardwood and white pine types. The Southern Forest Experiment Station has concentrated mainly upon long-leaf and slash pines, passing by many urgent problems of the short-leaf and loblolly pines, covering only certain phases of the management of some 40,000,000 acres of southern hardwood lands, and doing nothing whatever upon the swamp cypress type of forest. During the year Congress granted an increase for the work in the Appalachian region, thus permitting investigations to be extended at a more rapid rate.

Determining how best to raise and protect the forest crop requires the cooperative assistance of workers in

allied fields. The Bureaus of Entomology and Plant Industry have assigned a limited number of men to the study of forest insect and disease problems at the forest experiment stations. Similarly, the Biological Survey and the Bureau of Soils are aiding through special studies and assignments. There is need of an enlarged attack upon such related phases of the timber-growing problem.

The forest experiment stations receive many inquiries as to the essential measures whereby timber lands can be made and kept productive. To meet this need in part a series of papers is in preparation presenting for each forest region the basic principles of timber growing as far as now known. One bulletin in this series was published on the California pine region. One on the redwood region and one on the Douglas fir region are nearing publication. Most of the rest should be ready within two or three years.

One of the outstanding contributions of the year was the standardization of methods used in the preparation and presentation of volume and yield tables, which are indispensable to the forester in estimating standing timber and predicting growth. In this work, which was largely done at the forest experiment stations, the Forest Service had the cooperation of the Society of American Foresters and the Association of State Foresters. Studies of the growth and yield of the important forest types were continued and several basic and important preliminary phases were finished. They show how much woodlands of different productive capacity will yield at different ages and provide a basis for determining the value of lands for forestry, the product which can be obtained, and the length of the rotation. The studies on which the preliminary work has been completed concern the four important yellow pines of the Southern States, New England spruce, Lake States jack pine, Douglas fir in the Pacific Northwest, and yellow poplar in the Appalachian region.

Somewhat similar yield tables concern resin production from the southern pines. For several years the Southern Forest Experiment Station at its Florida branch has been studying the flow of resin from young longleaf and slash pines. It is now possible to tell how much resin trees of a given size will produce when chipped under conservative working. This study has indicated a close relationship between weather and the

resin flow, particularly with reference to the time when the trees are chipped. Investigations on the influence of weather may change the whole management of turpentine orchards.

#### FOREST ECONOMICS

Organization of the forest taxation inquiry, called for by the Clarke-McNary Act, was effected during the year by Prof. Fred R. Fairchild, previously appointed to direct the inquiry. The preliminary planning and selection of personnel have in large measure been completed, auxiliary material has been gathered, and methods of field study have been developed. The Lake States were chosen as the region first to be studied and field investigations were begun in Michigan in June. At the close of the year regional headquarters were established at St. Paul, in close proximity to the Lake States Forest Experiment Station. Subsequently a general canvass of sources of material was made, statistical studies covering the entire State were started in St. Paul, and plans were perfected for intensive studies in some half dozen of the more important forest counties, with a still more intensive investigation of certain townships in these counties. Invaluable assistance was received from officers of the State of Minnesota, the University of Minnesota, particularly the College of Agriculture, Forestry, and Home Economics, the Minnesota Tree Society, and numerous individuals.

Uncertainty as to whether timber growing will pay is greatly retarding its adoption by private owners. The practice of forestry would undoubtedly be profitable to a greater or less extent to-day in practically every important forest region in the United States. One of the reasons for economic studies is to learn more of the financial feasibility of private timber growing. Data should be gathered on the many elements making up costs and returns, on the conversion of going concerns with a large remnant of virgin timber now being "mined," to concerns growing their own permanent supplies, on the purchase of second-growth lands as a basis for perpetual operations, and on the starting of forests upon denuded lands. There is probably no line of work, unless perhaps the study of forest taxation, which should yield facts of greater stimulus to the development of forestry. Such studies will be prosecuted as available resources permit.



A comprehensive study of the economic consequences of extensive denudation of timberlands covered the former forest region of Michigan, where the after effects of lumbering and forest fires, along with the decline and death of forest industries, were compared with conditions in localities where part of the original timber is still standing.

A popular résumé of available data on forest resources of the world was prepared. Collection and compilation of statistics on the distribution and consumption of softwood and hardwood lumber were continued. Work was practically completed on a statistical bulletin comprising nearly 200 tables of data on American forests and forest products.

As in previous recent years, cooperation with the Bureau of the Census was continued in gathering information on the production of lumber, lath, and shingles. Statistics of wood preserved and preservatives consumed were obtained for 1925 and tabulated conformably to the established practice. This series extends back to 1909 and is the only official record of activities in the wood-preservation industry.

In studies dealing with forest economics records of past stumpage and lumber prices are highly important. The records in existence have been fragmentary. Considerable progress was made last year in the compilation of lumber prices for typical products and grades of the more important American timber trees, running back to 1800, although the early records are not continuous. A bulletin on stumpage prices is in preparation containing tables of such prices back to 1860, and a discussion of price trends since 1900.

#### FOREST PRODUCTS INVESTIGATIONS

The year has brought more definitely to view the integral relationship between research in forest products and silviculture. A notable instance is furnished by the hemlock and hardwood forests of the Lake States. Silvicultural studies had brought out the desirability of logging only the larger trees. Utilization studies had brought out that the smaller trees were being removed at a loss, and that defective trees were better adapted for ready-cut dimension stock than for boards. The Lake States Forest Experiment Station and the Forest Products Laboratory joined to dovetail these three conclusions in a definite system of woods and mill practice which

would combine the best silviculture with the best utilization. The findings have satisfied all expectations and are now being prepared for publication. If put into practice by landowners they will constitute the beginnings of industrial forestry in the hemlock and hardwood type.

Some years ago a study on how to select southern pine for structural timbers showed that the strength of pine wood is determined largely by the conditions under which the tree grows. An experiment is now under way to find out what conditions produce the strongest pine. When this is determined, it will be possible to tell the landowner whether his land is particularly adapted for growing timbers and what silvicultural system will produce them. Similarly, a study of how to select ash suitable for airplane construction showed that the strongest wood is found only in trees which have grown at a uniform rate. Rate of growth can be regulated by thinnings. Thus a study initiated to find out how to select lumber ended in finding out not only how to select but also how to grow it. The same results were found to apply to hickory for handle stock.

The interrelationship of forest products investigation and silviculture is not limited to forest utilization. The basic knowledge of wood which the Forest Products Laboratory is accumulating should throw light upon the most diverse problems, including the fire problem. A duff hydrometer, developed by the laboratory for measuring the moisture content of forest soils, has already proved a real contribution.

The year has also brought more definitely into view the integral relationship that exists between research in forest products and industrial reductions of waste. The idea that the forest-using industries can reduce wastes by voluntarily organizing to apply the results of research found definite expression in the National Wood Utilization Conference called by the Secretary of Agriculture in 1924. This conference resulted in a permanent industrial committee on wood utilization which is now functioning under the auspices of the Department of Commerce. Definite applications of the idea of waste prevention through industrial organization are constantly developing.

The Forest Products Laboratory has acted as technical advisor in the formulation of American lumber standards by the industries which use



wood. Standards for softwood yard and factory lumber, hardwood lumber, railroad ties, and structural timber are in process of formulation by these industries. In the many sharp conflicts of interest that necessarily attend such a process, there is constant need of technical advice, and for emphasis upon the fact that any standard, in order to be permanently acceptable, must be technically sound and must make for conservation. The increasing employment by industrial associations of men trained in products research and the increased demand for the short demonstration courses offered by the laboratory in kiln-drying, gluing, and containers are further proofs of the fact that the investigative work of the laboratory is of basic importance to the success of industrial efforts to curtail waste.

The relation of wood substitutes to forestry is a subject which has only recently gained attention. There has been a popular assumption that substitution by extending the life of the present timber supply would be beneficial to the public. This is true only if the substitute is of superior merit. If, however, wood is displaced not by superior merit but by superior pushing of the substitute, this merely creates uncertainty as to future wood requirements and harmfully discourages the growing of timber crops. The obvious function of forest products research is to provide facts about the properties and uses of wood on the basis of which the public can make its choice of materials intelligently. The substitution issue will probably give rise to a large number of new questions which will tax the capacity of the present products research organization.

Experience makes it increasingly clear that while decentralization of extension and consulting work should be encouraged, fundamental research in forest products, and technological research of Nation-wide application, gain greatly in effectiveness when centralized. For example, basic improvements in kiln drying, air seasoning, and wood preservation, and artificial modification of wood properties are now known to depend upon finding an answer to the single problem of how liquids exist in wood and how they move through it. In addition to the mechanical and chemical engineers heretofore engaged in these lines of work, it has been necessary to enlist the services of a colloid chemist, a mathematical physicist, and wood technologists. The help of a plant physiologist is needed next. By bringing

specialists from these diverse fields together and organizing a concerted attack upon the problem of liquids in wood, much progress is being made which would otherwise have been impossible.

The closing during the year of the Seattle timber-testing laboratory now centralizes all Forest Service work on timber tests at Madison. On the other hand, the laboratory short demonstration courses were extended into the field. There is need of a widespread decentralization of extension work, and of research on local utilization problems among forestry schools, State foresters, industrial associations, commercial laboratories, and consulting foresters and engineers. The past year has disclosed repeated instances in which industrial associations have established facilities to extend and apply research in forest products. There is also a growing need for qualified foresters and engineers to equip themselves for consulting work. The laboratory should to an increasing degree function as a clearing house and source of basic information on forest products, and to a decreasing degree as a consulting agency on local problems.

Notwithstanding the growing importance of forest products research the man-power available to the Forest Service has decreased. The Forest Products Laboratory now has 181 employees. During the war the number reached 450. The laboratory can not continue indefinitely to serve the increasing demands without an expansion of personnel.

Concrete examples of results obtained during the past year include the following: The effects of possible standard thicknesses for the so-called inch board upon its value for various uses, and upon the amount and nature of manufacturing wastes, were investigated more thoroughly than had heretofore been attempted. This investigation is still under way. Meanwhile the lumber standards conference adopted twenty-five thirty-seconds of an inch and twenty-six thirty-seconds of an inch as the thickness of the "standard" and "industrial" board respectively. Grading rules for hardwood lumber were studied exhaustively and a new basis for grading rules was arrived at which reduced wastes materially without impairing the quality of grades. The rules committee of the National Hardwood Lumber Association has recommended for trial a system of revised grades intermediate between the present grades and the new ones proposed by the laboratory. The

laboratory's recommendations for improved grades for structural timbers were adopted by the American Railway Engineering Association and the American Society for Testing Materials, and were recommended by the lumber standards conference for incorporation in the rules of the regional lumber associations.

The results of the laboratory's study of industrial outlets for softwood yard lumber were published. A mill study in the Inland Empire, conducted by the Idaho-Montana district, yielded valuable figures on degrade during river driving and figures on overrun and grade yields which afford a greatly improved basis for forest management plans and timber sales in that region. The mill and woods study conducted in the Lake States has already been described. A similar study will be made in the short-leaf pine stands of Arkansas this winter.

Further progress was made in working out on a laboratory scale the possibilities of the semichemical process for pulping hardwoods. The new plant of the Southern Extract Co. at Knoxville, Tenn., is now employing the new process to make board out of extracted chestnut chips. An adaptation of the semichemical principle was worked out for pine chips on a laboratory scale and now awaits commercial trial. Many mills adopted the laboratory's improved cooking methods for increasing the yields and quality of sulphite pulp, and the laboratory's recommendations for reclaiming fiber from white water.

Methods of simplifying the determination of moisture content of lumber were studied to develop a method sufficiently simple and rapid for daily use in sawmills, lumber yards, and wood-working plants. An easy method of determining moisture content would have far-reaching effects in improving industrial practice. The use of unseasoned wood has undoubtedly been one of the main causes of substitutes. Methods of reducing degrade in kiln-drying southern pine and in handling and drying gum were worked out in cooperation with several southern plants. A mathematical analysis was made correlating the effects of the various factors determining the transference of moisture through wood. This work may make possible radical improvements in seasoning methods and methods of modifying the hygroscopicity of wood.

A study of wood as a colloid was begun. A method was devised by which the total cross-sectional area of microscopic and submicroscopic open-

ings can be measured. These measurements will be of great value in learning how liquids exist in and move through wood.

An important discovery was made showing the general location and nature of the lignin in the cell wall. This was accomplished by a new technique in dissolving the cellulose and the extractives. The same idea can probably be used to determine the location of other constituents of the cell. The method of predicting the toxicity of preservatives from their chemical composition was further developed and verified. The chemical nature of the extractives in redwood was studied in cooperation with the California Redwood Association.

An analysis of the causes of brashness in spruce and Douglas fir was completed in cooperation with the Navy. Increased demands for information on tropical hardwoods could not be satisfactorily met because of the lack of definite information and funds for carrying on the necessary investigative work. Educational work in applying the results of past studies in increasing turpentine yields was successfully continued. A study was begun on the effect of changes in growth conditions on the structure of wood.

Methods which practically eliminate breakage in steam bending of chair parts were developed on a laboratory scale. This breakage has frequently run as high as 25 per cent. The application of these methods to commercial plants is the next step. To obtain data on the effect of soil moisture on the density and hence the strength of long-leaf pine, an irrigated experimental plot is being established on the Florida National Forest.

The study of glues and gluing methods was continued. The paint durability test fences maintained by the laboratory in various climates are yielding valuable indications of better methods of painting the various species and grades of wood.

The work of the laboratory for the coming year will be focused upon the further correlation of utilization with forestry, the analysis of substitutions for wood as related to outlets for forest products and the use of forest lands, and the prosecution of such basic researches as afford the key to improvements in wood use.

#### RANGE INVESTIGATIONS

On March 1 the office of grazing research was transferred from the



Branch of Grazing to the Branch of Research. This completes the combination of all the research activities of the Forest Service in one unit.

Grazing utilizes the subordinate vegetation in the forest. This subordinate vegetation has an important influence on timber reproduction, growth, protection and use, and on water flows; and the tree growth and water conditions in turn react upon the subordinate vegetation. The retention and improvement of the most fertile portion of the soil, the checking of erosion, watershed protection generally, and the support of wild life all depend on maintaining the proper interrelation of timber and forage. For this, as well as for producing the most complete and valuable forage crops, grazing research is essential.

In the Southwest especially acute problems are presented for solution. Prolonged drouth has decreased the growth of forage and the resultant overstocking has caused excessive depletion of many ranges. Research will seek better management methods in order that the overgrazing may be corrected without unnecessarily drastic adjustments in the industry. This calls for better knowledge of the value and growth habits of the forage plants, the possible ways of using them, the proper degree of utilization, and the systems of range management which will give the most economical results and at the same time assure maintenance of the carrying capacity and proper correlation of range use with other uses. Again, the rains fall at such a rate that it is often impossible for the soil to absorb more than a small part of the water. The lack of adequate vegetation to bind the soil has caused serious erosion in nearly all parts of the Southwest. This situation requires careful study particularly on such areas as the watershed above the Roosevelt Reservoir in Arizona. The specific factors which control erosion in the region must be determined and methods of range management developed which will allow the vegetation to play its full part in watershed protection.

The injury to forest reproduction by grazing in parts of the Southwest has prevented or retarded satisfactory restocking of approximately 550,000 acres. Research can aid materially to disclose how to insure timber reproduction without unnecessary sacrifice of grazing use.

The interest which stockmen are taking in the results of the Forest Service grazing research is indicated

by the success of the field-day demonstrations of the practical results of the range investigations held last year at the Great Basin Experiment Station in Utah and at the Santa Rita Range Reserve in southern Arizona. At the latter field day it was shown that under the experimental cattle management methods followed on the reserve, a profit of over 7 per cent was obtained from an investment of about \$85 per head, which compares with a loss of over 5 per cent on an investment of approximately \$55 per head on the unfenced adjacent range. The methods gave a larger calf crop, much smaller losses, and better quality cattle, with maintained production during the last 10 years, in 7 of which the rainfall was below normal.

A study of the distribution, growth habits, growth requirements, and value for pasturage of the important western browse plants was completed. Similar work is under way on the western range herbaceous vegetation. Intensive studies were continued at the Great Basin Experiment Station in Utah to learn the resistance of vegetation to different intensities and times of cropping. While too close and too frequent grazing seriously affects the vigor of the vegetation regardless of the period of use, the experiments have shown that if the grazing is not too close, if the first grazing is delayed until the plants have made a good growth, and if the intervals are sufficient to permit recovery from the shock of the previous cropping, it can be repeated twice or three times during the growing season without bad effects.

The cell tissue fluids of range plants were studied at the Great Basin Experiment Station in cooperation with the University of Minnesota to develop some definite relationships between these fluids and the growth habits and forage value of the plants. Determination of ways to improve the stand of the different forage species is the ultimate goal sought.

Study of artificial reseeding of mountain ranges continued. Three years' study of cattle range management on the Madison National Forest in Montana has yielded important results on the relation between the period of grazing and the quantity of forage that can be utilized without injury to the grasses.

The results of 11 years' study of the relation of herbaceous vegetation to surface run-off and erosion on high mountain watersheds were prepared for publication. Among the conclu-



sions are that properly controlled grazing will not injure watersheds on which the vegetation is in fair condition, but on badly depleted watersheds it may in some cases be necessary to exclude livestock, and that herbaceous vegetation exerts little influence on the amount of run-off and erosion from melting snow, but it does materially reduce the surface run-off and erosion in summer. However, as some 95 per cent of the total annual run-off is due to melting snow herbaceous vegetation has little if any effect on the total run-off.

A manuscript was completed on the utilization of mountain brush lands in southwestern Utah as summer range for cattle, embodying the results of five years' study conducted on the Dixie National Forest. The study determined the forage preferences of the cattle and showed the relationship between gains in weight and the character and amount of the browse. Conclusions regarding management methods were worked out. Additional data were obtained at the Santa Rita and Jornada Range Reserves concerning the effect of range use at different seasons.

With an enormous area of forest range available for livestock grazing, the development of an adequate scientific basis for range use so that it can take its place along with the growing of timber crops as a rightly integrated form of forest land use has

only begun. The same knowledge will serve also for, and is essential for, the development of efficient use of other public and private range lands. In this respect the case closely parallels that which is presented in connection with all forms of forest land use. The urgency of our national situation in forestry demands that the play of economic forces be facilitated and directed in the light of scientific knowledge. Only in barest outline is the economic knowledge now available for thoroughly satisfactory Federal, State, and private forest policies. And the same holds true of knowledge of the methods of timber growing. There is need to provide for the Federal contributions to forest research in a big national way, on a scale commensurate with the magnitude of the problem and the public interests at stake, building upon the regional forest experiment station plan of the department, as approved by Congress, and the work of the Forest Products Laboratory—already under way. Such provision can probably best be made by an organic act covering all the forest research in the Forest Service and perhaps also that in other bureaus of the department, rounding out existing authority, codifying existing law and carrying authorizations sufficient to provide for an ordered and systematic development for some such period as the next decade.









Grain Futures Administration

No. report published

for 1926





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## REPORT OF THE CHIEF OF THE BUREAU OF HOME ECONOMICS

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF HOME ECONOMICS,  
*Washington, D. C., September 1, 1926.*

SIR: I have the honor to present herewith the report of the Bureau of Home Economics for the fiscal year ended June 30, 1926.

LOUISE STANLEY, *Chief.*

HON. WILLIAM M. JARDINE,  
*Secretary of Agriculture.*

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The third year of operation of the Bureau of Home Economics was completed June 30, 1926. The purpose of the bureau is to study home problems by scientific methods and to send out the results in such a form that the home makers in every State can put them to practical use. For the past year, \$117,244 was available for study of problems affecting over 20,000,000 American homes. The total sum available for the current year is \$127,244. Care is taken to keep in touch with work under way in other laboratories so as to prevent duplication, and study is made of published results in order that any which are related to home making problems may be so applied. It is hoped by this means to shorten the interval between the discovery of scientific principles and their application in home practice.

There can be no question of the widespread desire for scientific facts on home making both by the family in the home and by the agencies that produce and handle the materials the home requires. The announcement by this bureau of even the preliminary plan for a piece of research brings a flood of requests for results from both these groups.

This increasing spread of home economics information to both producers and consumers is, of course, of great significance to the future of agriculture. Each year shows more clearly that its success does not rest solely on efficient production and distribution of its products. There must be a closer fit between consumption and production. The 20,000,000 American home makers must know how to make

the best use of food, textiles, and other materials the farm supplies. Also it is apparent that more attention must be paid to the standard of living in farm homes. It is a sign in the right direction, therefore, that many groups of people, and particularly home makers, are asking the help of science on home problems.

The work of the bureau is at present confined to three divisions—food and nutrition, economic studies, and textiles and clothing. Detailed studies are needed in the fields of housing and equipment, home relationships, and art in relation to the home, but can not be undertaken until larger appropriations are available.

The bureau has been adequately housed, so far as space is concerned, in one of the buildings of the Government hotels. No extensive changes in laboratory arrangement have been made this year, but equipment has been added as it has become necessary for new pieces of work. The textiles and clothing division has been hampered by the absence of a constant temperature and humidity room, but it has seemed unwise to install such a room in a building as temporary as this. The fact that research in this field is new has made it difficult to obtain the necessary equipment, and in some cases special equipment has had to be planned and made. This has been expensive and has increased the time required for delivery, but will be of advantage to other laboratories developing in this field.

The scientific staff has been strengthened during the past year by additions in the fields of economics, and textiles

and clothing. The number of scientific workers in proportion to clerical and custodial help has been increased. This has been made possible by reorganization of the clerical and custodial forces so as to get more economical utilization of their time. Arrangements have been made with George Washington University and with the University of Maryland by which specially prepared students have been used as student assistants. By this means we have obtained efficient sub-professional service and at the same time have contributed to the training of younger workers. Cooperative relationship has been established with the University of Maryland by means of which the facilities of our laboratories are to be placed at the disposal of their graduate students and they are to be allowed credit for approved pieces of work done in our laboratories.

Through the Office of Experiment Stations we have kept in touch with home economics research initiated in the States under the Purnell Act. Advice and help have been offered and personal visits paid the stations by members of the staff, to aid in planning new projects. Members of the staff have also served on the committees appointed to arrange for co-operative research in home economics under the Purnell Act. State workers undertaking new pieces of work have been sent here for conference and some have stayed for several days' work in the library or laboratories, so as to get in touch with the literature or the methods of work.

Cooperation with the women's organizations has been continued. Special material has been prepared for use in club programs and in their official organs. Plans are under way to use the various organized groups of women in the collection of data essential for a scientific study of home-making.

### LIBRARY

The library is growing in size and usefulness. Our aim is to make it not only a service library for the staff but the best available reference library on home economics in the country. Since books can be obtained quickly from the Department of Agriculture library and the Library of Congress, this is possible without having a large number of books on our own shelves.

Some work has been started on the preparation of bibliographies that are much needed in this field. A bibli-

ography on the fitting of shoes and other footwear is nearly completed. The librarian has begun work on a complete list of the printed contributions of the bureau and the two preceding branches of the department out of which the bureau grew. Such a list is of great practical use as well as of permanent historical value.

### FOOD AND NUTRITION

The work of this division has been very much hampered by lack of personnel. The expenditures in this field have had to be curtailed in order to provide for the development of the other lines of work. The sum available has only served for carrying on projects already under way, and there has been no opportunity for development of new lines of work that are very much needed.

### COMPOSITION OF AMERICAN FOOD MATERIALS

The data on food composition assembled for the revision of Office of Experiment Stations Bulletin 28, "Chemical Composition of American Food Materials," have been studied to determine figures that represent the proximate composition of foods that are important in the American diet. The study of meat started last year has been continued. New average figures on meat composition have been reached by statistical study of all available data. These have been associated with our present established commercial grades and represent more nearly than the earlier figures the composition of meat as purchased on the market. This compilation has shown such a regular coordination in the different constituents of meat that it is believed considerable saving can be made in the number of chemical analyses required in the cooperative study of meat production conducted by the department and the State experiment stations. The work on this section has been given precedence over other sections of this bulletin because of its close relation to studies under way, and the results have been prepared for publication as Department Circular 389, "Proximate Composition of Beef." A table on the yield of wholesale cuts of beef by grades was prepared for the 1925 Yearbook.

### MINERAL CONSTITUENTS OF FOOD

#### UTILIZATION OF CALCIUM FROM SPINACH

Among the requirements for a satisfactory diet, the supply of calcium is



more likely to be inadequate than that of any other mineral. Even though a food contains enough calcium to furnish the estimated body requirement there still remains the question as to whether the body utilizes it. Spinach, one of the most widely used leafy vegetables, contains calcium in an insoluble form and also oxalic acid. A metabolism experiment with seven normal women as subjects was carried out to compare the utilization of the calcium of spinach with that of milk when used in a mixed diet. It was found that the calcium of spinach is well utilized. The results of this study have been prepared for publication and will be sent to one of the scientific journals.

#### LOSSES OF CALCIUM IN COOKING

An experiment is in progress to determine the effect of the presence of salt in the cooking water upon the loss of minerals, especially calcium, during cooking.

#### VITAMIN STUDIES

In order that scientific facts on the relation of vitamins to health may be applied in the preparation of everyday menus, additional information must be had upon the occurrence of vitamins in human foods, and the influence of various methods of handling and preparation upon vitamin content.

Through the cooperation of the Office of Experiment Stations, Sybil L. Smith, specialist in biochemistry in that office, has compiled a table showing the distribution of vitamins A, B, and C in about 150 food materials, and a selected list of references to the literature reporting their occurrence and the technic of vitamin studies. This material has been issued in mimeographed form by the bureau, particularly for the use of those conducting research on vitamins in the State experiment stations and colleges.

Special attention has been given during the past year to the development of the details of methods for determination of vitamin content, since a number of the laboratories initiating work in this field have been looking to us for help. The question of the adequacy of yeast used as a source of vitamin B was raised. Several products were tested, and the quantity of one necessary to supply an optimum of vitamin B in the diet was determined.

A method for vitamin D determination has been developed. The technic of using the ultra-violet lamp to supply the vitamin D necessary in vitamin A determinations has been worked out.

#### LETTUCE

The comparison of the food values of green and white lettuce leaves has been under way since the establishment of this laboratory. The stock animals of the laboratory have been supplied one or the other form of lettuce in addition to the basal diet. This data will soon be ready for summary and conclusions.

As a supplement to this long-time study, the vitamin A and B content of lettuce has been determined, and experiments on the vitamin C content are almost completed.

#### HONEY

In cooperation with the Bureau of Entomology, the determination of the vitamin A, B, C, and D content of one sample of honey has been completed. A start has been made on the study of another sample, which differs widely in color. Previous studies on the vitamin content of honey have been sporadic, and it is our hope in this case to study completely sufficient samples so that definite statements can be made.

#### COD-LIVER-OIL CONCENTRATE

The vitamin A content of a commercial cod-liver-oil concentrate has been completed and the vitamin D content of this concentrate is now being determined.

#### DEMONSTRATION WORK

Groups of rats have been placed on diets recommended by the Ohio extension service, to show the value of additions of milk and fresh vegetables to the diet. Pictures have been taken at various stages for demonstration purposes, and the skeletons from one set of animals have been mounted for a permanent exhibit.

#### PROBLEMS IN FOOD PREPARATION

##### SOFT-WHEAT FLOUR

Work on flours from three classes of wheat was continued to show the variations required in proportions and methods of handling. These confirmed



the conclusions of last year that the softer flours yield more successful results when the proportions of sugar and yeast are slightly increased; also that the softer flours gave best results when the mixing was not too severe. A member of the staff of the bureau has worked with the departmental committee on standardization of bread-making tests for hard-wheat flour.

#### COOKING OF MEAT

In connection with the cooperative meat-production project considerable work has been done toward developing a standard method for cooking and testing the flavor of meat. It has been observed that beef roasts brought to a final temperature of from 61 to 63° C. are of desirable medium-doneness. The average rise in temperature after removal from the oven was 5°. Successful results in roasting were obtained when after the preliminary searing, usually at 250° C., the temperature was lowered to 125° C. for the remainder of the period of cooking. At this temperature the roasts required approximately 20 minutes per pound to reach the required temperature. This time can be shortened by cooking at a higher temperature, as 150 or 175° C., but the evaporation and dripping losses increase and there is less uniformity of doneness, as compared with meat cooked at the lower temperature.

Since lamb is generally liked better done than beef, it was found desirable to cook it to a temperature of 83° C. at the center of the roast. At this internal temperature there is less rise after removal from the oven. When the cooking was completed at 125° C., 45 to 60 minutes per pound was required. Increasing the temperature to 175° C. decreased the time per pound to approximately 26 minutes but increased the evaporation loss and yielded a less palatable product. So many different factors help determine the time required per pound that the above figures can only be looked upon as comparative. The more bony roasts, such as the shoulder cuts, required even longer times, with higher evaporation.

In connection with this work considerable time has been spent on the study of methods of controlling oven temperatures and the variations in temperatures in the different portions of the oven. This preliminary study has indicated the need for more detailed work on this problem.

Some of the cooperators report a higher searing temperature desirable and suggest that the cooking be finished at an even lower temperature than 125° C. The practical question presents itself as to the best methods for the housewife to use. It seems possible that the searing can be done more economically under a broiler and the cooking finished in an oven regulated at the low temperature found desirable. The present recommendation to sear in the oven at a high temperature, which must be reduced markedly for the completion of the process, is decidedly wasteful of fuel.

The whole question of the temperature variation in different portions of the oven is perhaps closely associated with the degree of ventilation of the oven. The influence of an unventilated oven upon flavor in the roasting of meat needs to be studied.

The roasts were all scored for their palatability by an interdepartmental committee. As the result of this work a score card for the assignment of numerical values to the different factors which affect palatability of meat has been prepared. The results of these studies will be a guide in developing methods of production which will yield the types of beef demanded by the market.

#### VEGETABLE COOKERY

Work on the cooking of vegetables has been continued, with special attention to methods which will preserve the mineral and vitamin content. It is hoped that during the current year results of the work during the last few years may be issued in the form of a brief and practical bulletin on vegetable cookery.

#### QUANTITY RECIPES AND FIGURES ON WASTE

As a by-product of other work of the bureau, a number of recipes for quantity cooking have been developed and will be published as opportunity permits. Records have been kept of the amount of refuse in the preparation of all foods used in the laboratory. These are being summarized, and will be used in connection with the compilation of the figures on the chemical composition of food materials and in the estimates necessary for the dietary survey.

A large proportion of the time of the staff of the experimental kitchen has been spent in testing products

sent in by other bureaus and in checking recipes to be sent out in press releases, over the radio, and in answer to miscellaneous requests.

## HOME PRESERVATION OF FOODS

### CANNING

The work on home-canning problems has been continued. The bulletin on home canning of fruits and vegetables, which has been in preparation for the last two years, was released in May, and up to the present time nearly 250,000 copies have been distributed. Special work has been done on canning asparagus and different varieties of beans, and the spoilage records substantiate our earlier conclusion that these vegetables should be processed under pressure.

A list of the problems in home canning considered most pressing by the extension agents has been collected and will serve as the basis for further work. The experimental records available on this subject are being assembled, and any problems not yet solved will be made the basis of our experimental program.

Work is under way to find the heating curves for vegetables packed hot in glass containers of different sizes as compared with tin cans. Special equipment has had to be ordered for this, so the work has been delayed.

Since the recommendations in regard to the removal of fat from meat in canning are so conflicting, a series of experiments was run comparing the keeping of lean lamb with some containing a large proportion of fat. This has been canned in accordance with the methods previously found to be successful and will be checked during the coming winter.

Special requests have come from home demonstration agents for directions for canning whole-wheat cereal and suet puddings. These have been prepared and canned and will be ready for checking as soon as a satisfactory interval of time has elapsed so as to be sure the products are keeping.

Some samples of vegetables canned during the years 1919 and 1922 were opened and scored. It is hoped that during the coming fall data on spoilage with different temperatures and times of processing can be prepared for publication.

Fresh black-eyed peas were canned and compared with the cooked dried peas. There was not sufficient difference in the quality of the product to justify the time required for canning.

Brining as a method of home preservation of vegetables has been studied and methods have been worked out by means of which these products can be used as substitutes for fresh vegetables, as well as in pickles. Special attention has been given to the development of satisfactory pickle recipes.

Since many complaints of color changes in canned fruits came to the bureau last year, various fruits were canned in glass jars and in lacquered and unlacquered tin cans. These have been opened and scored. The highly colored fruits showed least change when canned in glass, and less change in the unlacquered than in the lacquered tins. The unlacquered tins were badly corroded in some cases. The fruits with little color, as peaches and pears, showed less change in tin than in glass. There was a tendency for these to become darker when canned in glass. Study of the causes for this is being continued.

### REFRIGERATION

During the past year studies of electric refrigeration for the home have been begun. The attack has been from the physical and engineering side. One mechanical-refrigerating unit, lent and serviced by its manufacturer, has been installed in the bureau in a modern cabinet lent by its maker. Records have been kept of the temperature of the room, the refrigerator temperature, and the amount of current used. The outfit has operated perfectly without attention other than a periodical cleaning of the food space of the chest and an occasional defrosting of the cooling unit therein, oiling of the motor, and wiping of the machinery and cooling coil. Records of the electric current consumed, of the operation of the motor, and of the temperature of the room, and of points in the box have been accumulating for several months but have not yet been interpreted.

## ECONOMIC STUDIES

### FOOD CONSUMPTION OF FARM FAMILIES

The analysis of the diet of farm families which was started last year has been continued. The data for this study are taken from the schedules of the survey of farm standard of living made jointly by the Bureau of Agricultural Economics and this bureau.

During the year the average quantity and cost of each foodstuff con-



sumed by farm families have been determined for seven States, covering 1,837 families (Alabama, 200; Kansas, 406; Kentucky, 365; Missouri, 178; North Carolina, 220; Ohio, 382; Vermont, 86). The nutritive value of these average diets has been calculated in terms of calories, protein, calcium, phosphorus, and iron, and the distribution of the total calories and the total cost among the various food groups has been shown.

Two preliminary reports of these results have been prepared, one for Kansas, Kentucky, Missouri, and Ohio, now ready for mimeographing, and one for North Carolina, sent only to cooperators in that State. In these reports comparisons have been made with results from other dietary studies and with standards of good nutrition.

For three States, Alabama, North Carolina, and Vermont, the diet of each family has also been analyzed from the standpoints of nutritive value, cost, and the relation of these to the amount of food furnished by the farm. In this analysis, the short-cut method of calculating nutritive value, which was worked out last year, has been used.

During 1926-27 the diets of the 382 Ohio families will be analyzed. This will bring the total number of individual family dietaries analyzed to 1,253 (Alabama, 200; Kentucky, 365; North Carolina, 220; Ohio, 382; Vermont, 86). The average consumption figures in quantities and costs of each foodstuff will be found for the remaining States for which reliable food data are available. Probably about 12 States, including approximately 3,000 families, will be covered in all. Preliminary reports will be published for the five States for which the individual family diets were analyzed, and the results of all of the work on the farm-food schedules will be brought together in a bulletin.

#### SHORT-CUT METHOD OF CALCULATING THE NUTRITIVE VALUE OF DIETS

The short-cut method of calculating the nutritive value of diets has been further checked during the year against the usual long method. Figures on the average food consumption of large groups have been used for the testing. The results fall within a few per cent of those obtained by the long method, although the time required is only one-fourth that consumed by the long method. The method, therefore, has been written

up and sent in mimeographed form to the colleges and universities, where it is being given further trial. During the coming year it will be revised in the light of these results and made available in printed form, with explanation of its advantages and limitations.

#### SUMMARY OF FOOD-CONSUMPTION STUDIES MADE IN THE UNITED STATES

Before new studies are started of the food consumption of the American people, it seemed advisable to review carefully all of the work previously done in order to determine what parts of the field are most in need of further study and what methods of study will prove most successful. Such a review has therefore been made, and the results brought together in a convenient summary, showing in tabular form the method used in each study for collecting the data, the extent of the analysis, the number and types of families studied, and similar facts. This summary, which has been put out in mimeographed form, has proved most useful in two national conferences on studies of food consumption, one held in Washington, D. C., in April, under the auspices of the Bureau of Home Economics, and the other at the annual meeting of the American Home Economics Association, in Minneapolis, Minn., in June. During the coming year a more detailed report will be prepared.

#### FOOD-CONSUMPTION DATA BY THE ACCOUNTING METHOD

Both the summary of previous food-consumption studies and the results of the study with farm families by the survey method point to the need of new data obtained from actual records of food consumption. Forms and directions have therefore been drawn up for food accounts by means of which housewives can record from day to day the quantity and cost of each foodstuff consumed by the family and the amount of edible waste. The records will usually be kept for periods of two weeks, at from two to four seasons of the year. In order to direct and encourage the housewife in the work, several visits will be made to her by a field agent.

This accounting method is now being used by a number of colleges and universities for collecting data on food consumption of individual families or of institutional groups. During 1926-27



it will be further tested and its results compared with those obtained by the survey method and also by an accounting method in which the records are kept by a field agent rather than by the housewife. On the basis of these comparisons of methods a more extensive collection of food data will then be started.

#### CLOTHING EXPENDITURES OF FARM FAMILIES

The survey of farm standards of living has given data on the clothing as well as on the food expenditures of farm families. During the year these figures have been analyzed to show the kind and cost of clothing purchased by the various members of the farm family and some of the factors influencing these expenditures.

For 1,337 families the expenditure for each article of clothing purchased during the year was found for husbands and wives and for sons and daughters of seven different age groups. The resulting table shows the number of persons purchasing, the average number of articles of each kind purchased per person, and the average cost of each article.

These figures are considered sufficient for this detailed tabulation by articles of clothing. A larger number of families are being used, however, to show the total yearly expenditure for clothing for each of the 15 age and sex groups, and the relative expenditure for each group in terms of the husband's expenditure. The distribution of the total expenditure among six different classes of clothing is also being found. This tabulation, which will soon be completed, will include 2,010 families, from seven States, with separate averages for each State.

In order to determine the influence upon clothing expenditures of the size of the family income the schedules (except those of Kansas) are classified in four different groups, according to the size of the expenditure per family for all items of the family living. This method of classifying, which ignores differences in size of family, was found to serve the purpose as well as a classification by total expenditure per person, and was used because it was the quicker method. The influence of climate, of marriage, and of size of family upon clothing expenditures have also been investigated. Some of the results of this work have already appeared in a preliminary report on "Average Quanti-

ties and Costs of Clothing Purchased by Farm Families."

On the basis of this study of actual clothing expenditures, suggested clothing budgets have been drawn up for the farm operator and home maker and for sons and daughters of seven different age periods. These budgets conform to a standard of living for the farmer comparable to that described in budgets for the industrial family as a "health and decency level." This material has been presented in a report which will soon be ready for mimeographing. In the fall of 1926 all the work on this clothing study will be completed and the results brought together in a bulletin.

#### METHODS OF HOUSEHOLD BUDGETING AND ACCOUNTING

The need of satisfactory forms for the planning and recording of family expenditures is at present keenly felt, both by those assisting the individual home maker in the management of the family's finances and by research workers studying standards of living. Since the form of account book most widely used to date has proved unsuccessful with a great many families, a number of alternative forms have been prepared and tested out with farm and with city home makers.

The study has considered not only methods of recording cash expenditures but also methods of planning or budgeting expenditures and of recording income receipts, supplies furnished by the farm, and other special items. The part which the home maker plays in the management of expenditures and the use of checking and of charge accounts has also been determined, as the practice in these respects influences the type of accounting which will prove successful.

As a result of this study two forms of account books have been selected. One is suitable for use by home makers who have some experience or aptitude in household accounting and are able to plan and record their expenditures without direct assistance. The other form, which is exceedingly simple, is prepared for home makers who can not be expected to do more than enter their expenditures in journal fashion without classification. With these home makers frequent visits by a field agent are necessary to encourage and assist in the keeping of the accounts and to classify and analyze them with the home maker so that they may serve as a guide to wiser spending.

A bulletin presenting the results of this study and illustrating and explaining the forms of account books is now in preparation. Meanwhile, to meet the many requests for information on methods of handling household finances, a small circular, "Planning Your Family Expenditures," was printed.

#### COMPARISON OF METHODS OF COLLECTING DATA ON FAMILY EXPENDITURES

Most of the data on family expenditures so far collected by various agencies have been obtained by the survey method, in which the home maker recalls the previous year's expenditures in response to questions put by an investigator. Although it is recognized that some error must be present in such figures, the extent and nature of the error are not known. Before collecting new data on family expenditures, therefore, it has seemed desirable to compare the figures obtained by the survey schedule with those obtained from accounts kept by home makers. Plans and blanks for such a study have therefore been drawn up and will be first used in July, 1926, with about 50 farm home makers in Maryland.

On the basis of the results of this first study, the plans for the study will be revised where necessary and figures will be obtained from home makers in other localities, either with or without the "control" schedules. It is probable that the two sets of expenditure figures will be needed from about 100 home makers in all. In making this study the question of food data will be given special attention, and there will be close cooperation between this division and the division of food and nutrition.

#### SUGGESTED BUDGETS FOR FARM FAMILIES

It is the almost unanimous opinion of those who are assisting the home maker in the management of her family's finances that some sort of "ready-made" budget is necessary as a starting point. For although each home maker must work out her own plan of expenditure, suited to the particular needs of her family, she is usually unable to proceed without a printed budget from which to work. Such suggested budgets have been made available for city families by the budget-service departments of banks and by social workers, but no material whatever has been published for farm families.

The preparation of "suggested" budgets for farm families of various sizes and income has therefore been started and will be completed during the coming year. The data on family expenditures for several thousand farm families, obtained by the survey method, will form the chief basis for this work, supplemented by household accounts from the Maryland study mentioned above and from the extension departments of several States. These figures on actual expenditures will be checked for adequacy and balance against our present scanty knowledge of the relation of expenditure to health. Where scientific knowledge fails, common sense and common standards will be called upon. For the food and clothing items the assistance of specialists in these lines will of course be obtained.

#### EXPENDITURE SCALES BY AGE AND SEX

In comparing the expenditures of one family or group of families with other families or groups, allowance must, of course, be made for differences not only in the number of persons in the family but also in age and sex. The most satisfactory method of making this adjustment is by the use of scales of relative expenditure, in which the cost of the "living" of each individual is expressed in terms of the average married man's expenditure. The number of "adult-male units" to which each family is equivalent can thus be found, and the total family expenditure can then be reduced to the expenditure per "adult-male unit."

Such expenditures scales have already been drawn up in the division for the food and clothing expenditures of farm families. The remaining items of family expenditure will be considered during the coming year, using the data from the survey schedules and the household accounts mentioned above. The scales for the various items will then be thrown into a single scale, covering all family expenditures. After testing the accuracy of the figures, a report of the work will be issued.

#### PRESENT USE OF TIME BY HOME MAKERS

The study of the present use of time by home makers, which was started by the division in 1924, was selected as a national project by the Purnell committee on rural home-management studies. In consequence, four States have undertaken the study



under Purnell funds during the past year—Oregon, Rhode Island, Idaho, and Washington. All of these States have received from the division the blanks and instructions for collecting the time data and the classification of home makers' activities, which we have developed. Detailed directions for editing, classifying, and tabulating the records are also being sent to the State workers.

Two new forms have been added during the year to the material used in the study, one a second form for the recording of time expenditures by the housewife and the other a form for the plan or schedule of housework. The blanks for recording help and for reporting supplementary information and the instructions to the home maker have been considerably revised and are now in final form.

Emphasis has been placed during the year on working up the procedures in editing, classifying, and tabulating the records. These procedures have been written up in detail in order that the records may be handled in the same way by the various bureau and State workers and the results from the different sets of records made comparable.

At the present time satisfactory weekly records are on hand from 217 home makers, in addition to several hundred which are soon to be sent to us from two of the Purnell studies. During the coming year the classification of these and probably of between 100 and 200 new records will be completed, and the analysis of the records of the farm home makers and possibly of the town home makers, will be made and the results presented. For some types of home makers, however, the work will doubtless run into the year 1927-28, unless the Purnell workers obtain and tabulate records from a large number of home makers, thus reducing the number which we must handle.

#### TIME SPENT IN CARE OF INFANTS

In addition to the time study of all of the home-maker's activities, described above, more detailed studies are needed of the time spent in specific tasks. Of these none are so important as the care of children. The study of the time spent in the care of infants, started last year, has therefore been continued to the extent of obtaining 20 additional weekly records, which brings the total number of records to 47. The records collected last year have been assembled for a short

article, which appeared in the March number of the *Journal of Home Economics*. During the coming year more records will be obtained and a final report made for children under 12 months of age. At some later time the study will be extended to include children in their second and third years.

#### TEXTILES AND CLOTHING

In this division a beginning has been made in the scientific study of the problems of home laundry work. Some time has been required to develop a satisfactory and scientifically accurate method for determining the most effective temperature for the removal of soil from textile fabrics. Methods of removing the sizing from fabrics and artificially soiling them have been studied and satisfactory methods chosen. A special battery of washing machines has had to be made for this study. This has been designed so that it can be kept at a constant temperature. Several methods for determining the amount of soil removed during washing have been studied, and since this is a new field of work it has been decided to use in the final study the three most satisfactory methods, one colorimetric, one photometric, and one involving weighing. This will not only furnish data as to the amount of soil removed but also information as to the most satisfactory method of determining this.

A study of the literature on the scorching temperature of textile fabrics during ironing has been made and the apparatus for the experimental work is now being assembled.

A study of sizing formulas for home laundering is being made to determine the advantages of using various kinds of starch and additional ingredients in starching mixtures. Many formulas of this kind are advocated in books on laundering and commercial sizing, with contradictory statements as to their value. The qualities which are usually discussed more or less empirically in this connection are softness, smoothness, penetrability, adhesiveness, stiffness, and pliability. Attention is directed at the present time to the last three.

The method reported in the literature by Grimshaw for determination of stiffness has proved satisfactory for measuring this quality. Details of applying the starch and preparing the fabric in order that uniform conditions may be maintained have been worked out and preliminary tests with



commercial starches made. As soon as starches of known origin are available, the final runs can be completed.

A large amount of work has been done on developing a method of measuring pliability. Preliminary studies based on the "feel" of the fabric, which is the only method reported, showed the impossibility of getting accurate results in that way. A thorough investigation of instruments and methods used for similar purposes in related fields, such as paper, paint, and glue testing, was made, but none of these proved usable. It was finally decided that the only satisfactory method would be to prepare films of the starch and test the pliability of these on an instrument, the principle of which would be similar to the M. I. T. paper folding endurance tester. Preliminary work has developed the method of preparing these films in a satisfactory manner and an instrument delicate enough to test them is being built. It is expected that this instrument will be useful for the testing of the "cracking" of silk, and for the study of paint and glue films as well as starch. It thus should be a valuable contribution in the field of physical testing instruments.

Adhesiveness is another property for which no method of measurement has been developed. Investigation of glue-testing instruments, including those at the forest products laboratory at Madison, Wis., has given some helpful suggestions, and preliminary tests have been made with various kinds of starch joints, using fabric as a foundation. The strength of these joints is being determined in a tensile-strength machine.

Since some authorities hold that the variety of the cereal or tuber from which the starch is taken and the maturity of the plant at time of harvest affect the properties of the starch, it seemed imperative that the origin and history of the starch being tested should be known. Effort was made to obtain such starch on the market and through the various bureaus of the department. This was found to be impossible, and it became necessary to prepare the starch on a laboratory scale. This was done at the color laboratory of the Bureau of Chemistry, where semicommercial apparatus large enough for the purpose was available.

Wheat starch was made from wheat flour milled at the Kansas Experiment Station from Kharkof wheat. Potato starch was made from Russet

Rural potatoes selected by a member of the Bureau of Plant Industry. Cornstarch was made from Boone County white corn grown at Arlington Experiment Farm, near Washington. Fortuna, Early Prolific, and Blue Rose rice were obtained through the Louisiana Experiment Station. Starch from each of these three varieties is to be compared, since it has been learned that an effort is being made to develop an American rice-starch industry, and results on these chief American-grown varieties would be very helpful in that connection. Arrangements have been made through the Hawaii Experiment Station for canna starch, with which much experimentation has been done by the department. About 150 pounds of starch from these sources was prepared and is now being purified.

#### GARMENT FITTING

The study of garment fitting mentioned in the 1925 report is being continued. The experimental work is under way and a plan for taking silhouettes of characteristic figures has been formulated in order to obtain illustrations to be used in the publication of the results.

The study of the home-sewing practices of women throughout the country is also being continued. Approximately 1,100 questionnaires have been tabulated. The results will show the problems upon which the women need help.

The project dealing with designs in children's clothing, which was started last year, was discontinued because of pressure of other work and has recently been taken up again. The work done by other institutions in the meantime has changed our plans somewhat and the actual scope of the problem can not be stated until the survey of the literature now under way has been completed.

The anthropometric study started last year was discontinued for the time being because of lack of funds. It was then planned to take body measurements of individuals of both sexes from 2 to 21 years of age. The results were to be used as a basis for pattern making and construction and fitting of garments. The great interest shown during the past year by manufacturers of patterns and ready-to-wear clothes as well as the needs of women expressed through the clothing specialists of the extension service make such a study of extreme importance at this

time. It is hoped that plans for carrying it forward can be developed this coming year in connection with some work to be done on the preschool child. This will further aim to establish measurements of the normal American child which will be of anthropological value as well as of help in the formulation of standards of good nutrition.

At the request of the National Committee on Prisons and Prison Labor, a member of the staff was sent to New York City and to the New York State Reformatory for Women at Bedford Hills, N. Y., to advise with them in developing suitable clothing for the inmates of such institutions, which might be developed in the small factory located there. The following was accomplished:

Four sample styles of underwear were made, of which one was chosen by reformatory officials for wear by inmates. Charts were made for use in the cutting out of all children's clothing, adult dresses, and underwear, in order that the material might be used as economically as possible. Patterns were supplied in five sizes each for brassieres, combination underwear, costume slips, and dresses, three sizes each for bloomers and middies to be used as athletic suits, two sizes of children's dresses, rompers, and bloomers, one size baby slip, and one size baby jacket. Officials in the garment industry in New York City were interviewed in order to learn as much as possible concerning the women's underwear industry since the reformatory was particularly interested in that phase of the problem and also in order to make as many contacts as possible in the interest of the anthropometric study we hope to undertake.

The printing of Farmers' Bulletin 1449, entitled "Selection of Cotton Fabrics," was completed and almost at once the first edition was exhausted, so great is the demand for information on the selection of textiles. A similar bulletin on wool is in preparation and will be followed by one on silk.

Farmers' Bulletin 1497, entitled "Methods and Equipment for Home Laundering," has been prepared to replace the former bulletin on home laundering, and is now printed and available for distribution.

A revision of Farmers' Bulletin 861, entitled "Removal of Stains from Clothing and Other Textiles," and a farmers' bulletin on "Principles of Window Curtaining" have been submitted for publication.

As dress revues and various other contests in clothing selection and con-

struction have gained in popularity in school and extension programs, leaders have been asking where they could get standard score cards. The great variety of cards now being used has been a serious handicap to many, particularly in country-wide elimination contests. To meet this need 22 score cards for judging various types of contests have been compiled by this division and are ready for issuance in mimeographed form. These make no claim to being ideal, but it is believed that they embody the best points of all those now in use and that they give greater educational value to such contests.

The lantern slide set entitled "What Shall I Wear," and the syllabus and notes to accompany it, has been completed and is now being distributed by the Office of Cooperative Extension Work. This gives the elementary principles of costume design and illustrates them with costumes for mature women. The slides are therefore particularly useful for clubs of rural women organized through the extension service.

Material for another lantern slide series entitled "First Aid in Window Curtaining" has been submitted to the Office of Cooperative Extension Work. The necessary lettering and drawing is now being completed there.

This division has been responsible for abstracts to current literature on textiles and clothing, published in the Journal of Home Economics every other month.

## PUBLICATIONS AND PRESS MATERIAL

Technical and popular information reporting the work of the bureau have continued to be sent out in the form of bulletins, of articles for periodicals, scientific journals, and newspapers, and of releases for broadcasting by radio. The response from this material is an immediate and increasing demand for more. The first editions of several bulletins have been exhausted almost as soon as they came from the press.

During the past year the following publications have been issued in the regular series of the department:

Selection of cotton fabrics. Ruth O'Brien. Farmers' Bulletin 1449.

Canning fruits and vegetables at home. Louise Stanley. Farmers' Bulletin 1471.

Methods and equipment for home laundering. Division of Textiles and Clothing. Farmers' Bulletin 1497.

A guide to good meals for the junior home maker. Ruth Van Deman and

Caroline L. Hunt. Miscellaneous Circular 49.

The following publications are in press:

Proximate composition of beef. Charlotte Chatfield. Department Circular 389.

Planning your family expenditures. Chase G. Woodhouse. Miscellaneous Circular 68.

Stain removal from fabrics: Home methods. Division of Textiles and Clothing. Farmers' Bulletin 1474.

Manuscripts for two more farmers' bulletins have been submitted for publication:

Principles of window curtaining. Mary Aleen Davis.

Convenient kitchens. Greta Gray.

The preliminary reports and subject matter issued in mimeographed form are as follows:

Average quantities and costs of clothing purchased by farm families. Edna Clark, Bureau of Home Economics, and E. L. Kirkpatrick, Bureau of Agricultural Economics.

Vitamins A, B, and C. Sybil L. Smith, Office of Experiment Stations.

Two hundred special articles and press releases describing the work of the bureau or reporting some special piece of research have been sent to newspapers, magazines, and scientific journals. Included in these was a special series distributed in cooperation with Better Homes in America during

Better-Homes Week to the communities where demonstrations were held. An added feature of the information service this year was a biweekly series of radio releases of approximately 2,500 words each, popularizing the scientific facts on nutrition and food selection and preparation. Twenty-six such releases were sent during March, April, and May to 38 stations for broadcasting in various parts of the United States. The response to these releases has been so favorable that it is planned to continue them during the coming winter.

#### EXHIBIT MATERIAL

Help was given in the preparation of exhibits for the National Livestock and Meat Show, and one of the specialists from the bureau went with the exhibit.

Considerable time was spent by specialists in the bureau in the preparation of exhibits for the Sesquicentennial Exposition.

In cooperation with the extension service a series of posters on kitchen arrangement has been planned and is now being prepared.

Some time has been spent in planning educational films on home economics subjects. One on child nutrition has been started, and it is hoped that it and at least one other will be completed during the coming year.







DEC 14 1926

EXPERIMENT STATION FILE

## REPORT OF THE INSECTICIDE AND FUNGICIDE BOARD

UNITED STATES DEPARTMENT OF AGRICULTURE,  
INSECTICIDE AND FUNGICIDE BOARD,  
Washington, D. C., August 26, 1926.

SIR: I have the honor to transmit herewith the report of the work of the Insecticide and Fungicide Board for the fiscal years ended June 30, 1925, and June 30, 1926.

Respectfully,

J. K. HAYWOOD,  
*Chairman.*

Hon. W. M. JARDINE,  
*Secretary of Agriculture.*

The Insecticide and Fungicide Board is a regulatory body, charged by the Secretary of Agriculture with the enforcement of the insecticide act of 1910. The scope of the work is so varied that it directly affects not only agriculture and the insecticide and fungicide industry, but also, because of its application to disinfectants, affects the health of our people.

The insecticide act is designed to protect consumers of insecticides and fungicides (including disinfectants) by such Federal regulation of labeling and manufacture as will insure truthful claims of quality and effectiveness. It also provides for certain statements on the label relative to total and water soluble arsenic and active and inert ingredients and requires that products that are to be applied to vegetation shall not be injurious to same.

The vigorous enforcement of such a law affords a large measure of protection to consumers, but the funds available for this work do not permit the complete inspection of the labeling of every insecticide and fungicide which is being shipped into interstate commerce, and, in fact, such a stupendous undertaking would be impossible of accomplishment. The growth of the industry, however, necessitates increased activities on the part of the enforcement organization; otherwise there will be a disturbance of the ratio between regulatory inspection and shipments made.

The return of the farmer to prosperity must result in an increase in his capacity to purchase insecticides and fungicides and the necessity for inspection and control work is correspondingly enlarged. There are new remedies appearing on the market each year and new companies engaging in their manufacture; each new remedy and each new manufacturer presents a new problem to this enforcement organization.

The importance of this inspection work is everywhere recognized and it has been amply demonstrated that it results in improving the quality of the merchandise on the market and that it is a substantial control and check on untrue and misleading claims of effectiveness.

There is a marked tendency on the part of some manufacturers to write their labels on the basis of testimonials received from the general public, regardless of the training and experience of the writers. While actual use under practical conditions is the best criterion of the value of an insecticide or fungicide, such results can only be relied upon when the experiments are made by trained scientists and under very carefully controlled conditions. The average user is careless about such points as the dilution and number of applications recommended or apt to vary these until satisfactory results are obtained. The result is that the treatment found effective may be quite



different from the one recommended by the manufacturer. In other cases the consumer is not familiar with the pest infecting his crops and may apply the treatment about the time the pest is being controlled by natural means. In such cases the remedy is always given full credit for the disappearance of the pest. The only tests that may be considered reliable are those made by trained scientists who, from long experience, are fitted to properly weigh and evaluate all of the factors that enter into such experiments. If all the manufacturers of insecticides and fungicides could realize the absolute necessity for making adequate tests of their preparations before placing them on the market, they would save themselves and the public a great deal of unnecessary trouble and expense.

Although the law is punitive in character, the real purpose actuating the legislation was to obtain properly prepared and labeled material. The board has recognized this principle, and in the administration of the law a large amount of advisory work has been performed. Minor forms of misbranding are not reported to the courts for prosecution, but are called to the attention of the manufacturers and suggestions are made to them for properly correcting their labels. This method of procedure has produced excellent results and the board feels that it is a constructive means for carrying out the intent of Congress. This procedure entails an enormous volume of correspondence, which taxes to the utmost the small force engaged in the work. Thousands of labels and circulars are examined each year, and they are so varied in scope as to necessitate consideration of each one by scientific experts of several different branches of the department. By this means the labeling of preparations coming under the provisions of the insecticide act has been greatly improved, without litigation, and the board has obtained many improvements through cooperation with manufacturers, which, perhaps, would not have been possible otherwise. The trade as a whole has responded in a gratifying manner to the suggestions made, and corrections have been obtained in a much shorter time than would have been possible through litigation.

Therefore it will be evident that the cases referred to the courts have been only those disclosing serious violations of the law, or cases where by reason of

lack of cooperation on the part of manufacturers corrections in labeling could not be otherwise obtained.

The board has continued its campaign against preparations which are claimed to control chicken lice, chicken mites, blue bugs, and other external parasites infesting chickens, when fed to the poultry in the feed or drinking water. Tests have been made of a large number of such preparations and none has been found to be effective. A considerable number of seizures have been made of shipments of such articles and criminal prosecutions have been instituted under the provisions of the insecticide act. A number of these preparations have been withdrawn from the market as a result of the board's activities and the end of the fiscal year 1926 shows a decided improvement, but it will be necessary to continue this campaign further, since a number of manufacturers are still selling their fraudulent preparations.

The board has continued its campaign against various so-called boll-weevil remedies, which do not control the boll weevil when used as directed. Prosecutions have been instituted against a number of manufacturers. Further tests are being made this year at two points in the South, but have not yet been completed. Such action will be taken under the terms of the insecticide act as the facts justify. In carrying out these experiments it is necessary to test the products on a practical scale in southern cotton fields throughout the growing season.

Arrangements have been made whereby fungicides sold in the far West for use against plant diseases occurring, and under conditions existing in the West, can be tested against these diseases and under these conditions. A number of products are in course of test during the current season and it is hoped that the results will furnish the board data and knowledge that it does not now possess as a guide in the criticism of labels.

The campaign against adulterated and misbranded disinfectants of various kinds has been continued throughout the year. Special attention has been given to disinfectants which are recommended at too great dilution to be effective. As a whole, there has been a great improvement in the labeling of this class of goods.

The campaign started in 1921 to prevent the adulteration of pine-oil disinfectants and coal-tar disinfectants with mineral oil has been very suc-

cessful and it is seldom that such adulterated products are now found on the market.

The campaign inaugurated in 1919 involving inspection of the domestic supply of calcium arsenate to be used for cotton-boll weevil control, has continued. It was found that, for the most part, the calcium arsenate now being manufactured is of excellent quality, although there were a few cases of low-grade calcium arsenate referred to the Department of Justice for prosecution.

The campaign started during 1919 against insect powders adulterated with daisy flowers, insect flower stems, and turmeric, was continued. There has been an increase in the number of such adulterated shipments and several seizures and criminal prosecutions have been instituted.

The campaign against various household insecticides, the labels of which failed to bear the active and inert ingredient statement required by section 8 of the insecticide act, was continued. As a result of correspondence and prosecution, a decided improvement in the labeling of this class of goods has been brought about.

The well-recognized fact that paradichlorobenzene, when used at proper dosage in small air-tight containers, is an effective remedy against clothes moths, has led many manufacturers to assume that this material would be an effective repellent against all household insects, when simply sprinkled about a room. Extensive tests have shown that it is only effective as a fumigant, if the proper quantity is used in a container that can be made practically air-tight. This point has been brought to the attention of many manufacturers and has caused a very noticeable change in the labels for preparations of this type.

A campaign has been instituted during the fiscal year 1925 against import shipments of sodium cyanide and white arsenic to obtain the proper statement on the labels relative to active and inert ingredients. This campaign is progressing nicely and a general compliance with the law is being obtained.

A campaign has been continued against preparations which are recommended incorrectly to control certain forms of mange.

The inspection force has been giving special attention to the sampling of shipments of disinfectants officially permitted under the regulations of the Bureau of Animal Industry in the dis-

infection of cars, runways, quarters, etc., against infectious diseases communicable to stock and of preparations permitted in the official dipping of cattle and sheep for scabies and of arsenicals used in combatting the cattle tick, in order to check the quality and also that the labeling of these preparations may be examined as to their compliance with the provisions of the insecticide act.

A campaign was begun against a number of preparations which recently appeared on the market for use to combat flies infesting animals. The remedies consist essentially of mixtures of salt, sulphur, and either lime or charcoal. They are recommended for internal administration to the animals. The manufacturers claim that the chemical or chemicals to which the repellent action may be attributed is given off through the skin passing off in gas form which is obnoxious to the flies and thus assures freedom to the animals from the bites of the flies.

#### INTERSTATE SAMPLES

During the fiscal years 1925 and 1926 the board reported to the solicitor of the department 148 cases presenting alleged violations of law with recommendations that the facts be transmitted to the Attorney General to institute criminal action or seizure proceedings. Disposition was made of 464 cases by correspondence with the manufacturers. These cases presented violations which were technical only, not flagrant, or cases in which the manufacturer gave reasonable and adequate explanation of his failure to conform to the provisions of the act. Action was taken to place in abeyance 1,205 samples, which, upon examination and test, were shown to be in compliance with the provisions of the law or were from shipments of the same goods made prior to shipments for which the manufacturer had been convicted and had, after citation, conformed to the requirements of the law. On June 30, 1926, 80 cases were pending preliminary hearings or before the board for final action; 228 were held in temporary abeyance, pending the receipt of further information, or the outcome of prosecution based on the same product or correspondence with the manufacturers; and 659 samples were undergoing analysis and test.

The inspectors and sample collectors of the board, operating throughout the United States, collected sam-



ples from 864 shipments in 1925 and from 992 shipments in 1926. A general classification of the articles represented in the collection is as follows:

*Interstate samples collected*

Class of samples	Fiscal years	
	1925	1926
	<i>Num- ber</i>	<i>Num- ber</i>
Arsenate of calcium and boll-weevil preparations.....	38	45
Arsenate of lead.....	19	54
Bordeaux mixture and combinations of Bordeaux mixture with insecticides.....	29	45
Chlorinated lime.....	3	8
Cyanide preparations.....	12	7
Dips for animals.....	22	30
Disinfectants, germicides, bactericides.....	161	137
Fly preparations for animals.....	30	32
Fish-oil and whale-oil preparations.....	6	6
Formaldehyde preparations.....	11	10
Insect preparations, household use.....	164	193
Miscellaneous insecticide and fungicide preparations, agricultural use.....	91	150
Lice and mite killers.....	102	83
Lime-sulphur solution and sulphur preparations.....	41	54
Mange preparations.....	18	13
Nicotine preparations.....	25	22
Paris green.....	12	29
Pyrethrum and hellebore powders.....	42	29
Miscellaneous.....	38	45
Total.....	864	992

### IMPORT SAMPLES

During the fiscal years 1925 and 1926 782 official and unofficial import samples of insecticides and fungicides were collected through the various port laboratories of the Bureau of Chemistry for examination and test by the board. Disposition was made of 704 samples. Fifty-nine official samples were found adulterated and misbranded and it was recommended that the shipments be refused entry until correctly labeled. The remaining samples were unofficial, 120 of them being found to be adulterated or misbranded, or both, and in these cases it was recommended that future shipments be detained, while 522 were neither adulterated nor misbranded. Three official samples were found to be neither adulterated nor misbranded and the shipments were released.

### SPECIAL INVESTIGATIONS

The development of a method for determining free calcium hydroxide in

commercial calcium arsenate (published in *Industrial and Engineering Chemistry*, vol. 16, No. 9, p. 950, 1924) has been of great value to the board—enabling it to inspect and pass on the suitability for use on plants of a much greater number of shipments of calcium arsenate, and a more thorough examination of shipments than would otherwise be possible.

A systematic study of the effect of varying conditions such as temperature, concentration, time of digestion, etc., on the chemical nature of calcium arsenate made from hydrated lime and arsenic acid has been in progress since 1925. The object of this study is to discover why at times commercial calcium arsenate of the usual acceptable analysis injures plants. In this investigation 16 arsenates of calcium have been prepared and their properties studied. A number of these arsenates are new and the information obtained will be not only of scientific value but will give a better understanding of commercial arsenates of calcium. They can be prepared in sufficient quantity to study their relative values as insecticides. Tests also were made to determine the effect of magnesium oxide (MgO) in the lime used on the resulting calcium arsenate. The results have shown that as much as 6 per cent of magnesium oxide (MgO) appeared to be without effect in so far as the amount of water soluble arsenic in the finished product was concerned, provided sufficient lime were used to keep the available calcium hydroxide ( $\text{Ca}(\text{OH})_2$ ) up to the proper proportions.

Investigation of the active constituents of larkspur seed has been made during the last two years and the chemical work has been completed. The results of the work on the species *Delphinium consolida* have been published in a paper, entitled, "The isolation and properties of alkaloids and oil of larkspur seed (*Delphinium consolida*)" in the *Journal of the American Pharmaceutical Association*, vol. 13, No. 8, p. 696. Work on the species *D. staphisagria* is being written up for publication. The oil and alkaloids have been separated from both of these species, purified and their chemical and physical properties studied. Tests will be made (by the Bureau of Entomology) to determine their toxicity to insects.

An investigation that has been under way for some time for the purpose of determining the rate of loss of nicotine from nicotine dusts during stor-



age has been completed and results reported in Department Bulletin No. 1312, issued January 27, 1925. The information obtained as a result of this investigation will be of value not only to the user of nicotine dusts but to manufacturers and enable them to prepare and pack these dusts so as to retain their greatest efficiency.

The investigation carried on during the last two years to determine the rate of deterioration of bleaching powder on storage, has been completed and the results published as Department Bulletin No. 1389, entitled "Deterioration of Commercially Packed Chlorinated Lime." This investigation has also resulted in the accumulation of data which will be of value to the consumers of this material, to the manufacturers and packers of bleaching powder, and to the board in connection with the enforcement of the insecticide act.

An elaborate study of methods of testing disinfectants has been under way during the last year and is being continued. This includes a study of the correlation between the R. W. method and the "wet filter paper" test with various types of disinfectants, and the use of various pathogenic organisms in the standardization of disinfectants.

Working in cooperation with the Bureau of Entomology, the entomologists of the board have practically finished the work on the proprietary preparations administered in the food and drinking water for the control of external parasites of poultry and have also tested most of the ingredients found in these preparations. No evidence has been found to indicate that this method can be of any practical value for the control of the common external parasites of poultry. These data have been submitted by the Bureau of Entomology for publication as a bulletin.

In collaboration with the Bureau of Animal Industry, investigations have been made of the efficacy of hydrocyanic acid gas on cattle ticks and of the efficacy of certain drugs reported to have insecticidal properties against the mites of psoroptic, sarcoptic and follicular mange.

The pathologists of the board have continued special investigations of the efficacy and other properties of the more important types of fungicides now on the market, laying special emphasis on those products which are new in type or are new combinations of old types and also on newly devised or newly recommended methods of us-

ing the same. Special attention has been given in this work to the determination of the proper methods and times of application and the time of season when each type of fungicide may safely and effectively be applied. All of this work is planned and directed with a view to obtaining such information as is not available from other sources and which is essential for the use of the board in criticizing or directing revision of labels.

Since in the use of most fungicides it is necessary that they not only have toxic or fungicidal properties against the fungi in question but must also have such physical properties as will enable them to adhere to the plants satisfactorily, a special investigation is being made of various possible methods of testing and comparing or measuring the relative adhesive properties of such products. In this connection it might be noted that the possible success of dust fungicides seems to depend largely on their physical properties and for most diseases an extremely finely powdered form seems necessary for the best results. For this reason studies of the various dust fungicides, including representatives of practically all types available, all differing both chemically and physically, have been given special attention.

Further studies have been made of various commonly recommended combinations of fungicides with insecticides relative to the effect of such combinations on fungicidal action and the injury to plants. In this connection a study has been made to learn more concerning the conditions under which and the manner in which both lead and calcium arsenates may properly be directed to be combined with lime-sulphur, Bordeaux mixture and certain sodium polysulphide compounds. The possible effect of the addition of casein spreaders to such combinations as above mentioned, in preventing injury, as has been claimed by some manufacturers, has also been tested with some instructive data resulting.

The work with dry substitutes for liquid lime-sulphur has been completed and a portion of the results of the field experiments has been published as Department Bulletin No. 1371, entitled "Effectiveness Against the San Jose Scale of Dry Substitutes for Liquid Lime-Sulphur." The results show that none of the dry substitutes tested was effective against bad cases of the San Jose scale when used as directed by the manufacturers.

The bulletin has been brought to the attention of manufacturers and it is expected that efficacy claims will be altered to suit the findings of the board.

A considerable amount of work has been carried on with the various proprietary remedies for the control of house flies and mosquitoes and with

the different ingredients that are found in such preparations. Especial attention has been given to repellents and fumigants for flies and mosquitoes and larvacides for flies. This work is being continued and it is expected that a portion of these data will be prepared for publication during the coming year.







Saturday, December 18, (a m)

OFFICE OF EXPERIMENT STATIONS

DEC 14 1926

EXPERIMENT STATION FILE

## REPORT OF THE LIBRARIAN

UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE LIBRARIAN,

Washington, D. C., August 27, 1926.

SIR: I have the honor to submit herewith the report of the library for the fiscal year ended June 30, 1926.

CLARIBEL R. BARNETT,

*Librarian.*

HON. W. M. JARDINE,

*Secretary of Agriculture.*

The following report on the work of the past year is based on the manuscript reports made to the librarian by those in charge of the divisions of the main library and the branch libraries in the various bureaus of the department.

### USE OF THE LIBRARY

The use of the library may be said to fall under two main heads, (1) the circulation and (2) the reference service. By circulation is meant the record of the books and periodicals which are circulated to readers in response to specific requests. By reference service is meant the aid rendered in the use of books, the answering of specific questions, or the seeking out of material relating to a certain subject.

### CIRCULATION

The detailed combined statistics of circulation in the main library and the bureau libraries are given in Appendix 1. The total number of books recorded as circulated was 54,791. No records of the reference use are kept either in the main library or the bureau libraries. The total of the recorded circulation of current periodicals is 338,566, but this does not represent all the circulation, as the Office of Experiment Stations keeps no circulation statistics either of books or periodicals. No record also is kept of the circulation of periodicals from the main library to bureaus and offices, such as the Bureau of Biological Survey, the Bureau of Soils, the Solicitor's office, and the Secretary's

office, which do not have librarians in charge. It is estimated that this circulation is not less than 10,000, and that the circulation of books and periodicals by the Office of Experiment Stations library is not less than 50,000. Adding these two estimates, the total recorded circulation of books and periodicals makes a grand total of 453,357, but these figures are more misleading than informing as they represent most inadequately the actual use of the library.

### INTERLIBRARY LOANS

One of the most important services rendered by the reference assistants to the users of the library is that of linking up the resources of this library with those of other libraries both in and out of Washington through interlibrary loans. Extensive use is made of the resources of the Library of Congress, which in the routine of its invaluable service to Government libraries daily delivers and collects the books called for and returned by the department. For some reason not apparent the number of books borrowed from the Library of Congress during the past year was considerably less than in the previous year, the daily average being 10 as compared with 12 in the preceding year. Frequent use is also made of the Surgeon General's library and various other Government libraries. The exact number of books borrowed from the libraries of the city during the past year is shown in the following list:

Bureau of Education.....	4
Bureau of Ethnology.....	2
Bureau of Fisheries.....	11
Bureau of Mines.....	1

Bureau of Railway Economics	1
Bureau of Standards	23
Department of Commerce	2
Department of Justice	1
Geological Survey	49
Hygienic Laboratory	13
Library of Congress	3, 100
National Museum and Smithsonian	67
National Research Council	4
Patent Office	37
Public Health Service	5
Public Library	27
Surgeon General's Office	504
Weather Bureau	24
Total	3, 875

In addition to the books borrowed from libraries in Washington, 69 books were borrowed from libraries outside of the city as follows:

Arnold Arboretum	9
Boston Public Library	1
Chemical Warfare Service	3
Cornell University	1
Franklin Institute	1
John Crerar Library	7
Johns Hopkins Library	2
Lloyd Library	12
Massachusetts College of Pharmacy	5
Massachusetts Horticultural Society	1
Massachusetts State Library	1
Missouri Botanical Garden	1
Museum of Comparative Zoology	1
Philadelphia College of Pharmacy	1
Rockefeller Institute	2
University of Chicago	3
University of Minnesota	8
University of Missouri	2
University of Pennsylvania	5
University of Wisconsin	2
Washington State College	1
Total	69

Our interlibrary loan service has not, however, been limited to borrowing from other libraries for this library in turn lent many books to other Government offices and libraries and to libraries and scientific workers outside of the city. No separate record has been kept of the books lent to the Government departments; the distribution of the loans outside of the city is shown by States in the following table. It will be noted that all but two States are represented in the list.

Alabama	13
Arizona	5
Arkansas	29
California	54
Colorado	15
Connecticut	53
Delaware	78
Florida	73
Georgia	35
Idaho	12
Illinois	44
Indiana	41
Iowa	13
Kansas	11
Kentucky	16
Louisiana	17
Maine	1
Maryland	115
Massachusetts	62
Michigan	40
Minnesota	77
Mississippi	2
Missouri	54
Montana	25

Nebraska	23
New Hampshire	1
New Jersey	78
New Mexico	2
New York	158
North Carolina	39
North Dakota	15
Ohio	139
Oklahoma	15
Oregon	38
Pennsylvania	65
Rhode Island	18
South Carolina	30
Tennessee	7
Texas	26
Utah	57
Vermont	19
Virginia	47
Washington	39
West Virginia	30
Wisconsin	67
Wyoming	3
Canada	24
Guam	1
Haiti	5
Porto Rico	22
Total	1, 853

The distribution of the loans outside of the city, by institutions, was as follows:

Land-grant colleges and State experiment stations	1, 017
Department of Agriculture workers stationed outside of Washington	411
Colleges and universities other than land grant	124
Other scientific institutions	210
Business firms	48
Public libraries and miscellaneous	43
Total	1, 853

In addition to the 1,853 books, 153 photostat copies and 13 typed copies of articles were supplied, making a total of 2,019 loans for the year, an increase of 100 as compared with the year 1925.

## RECORD OF CHARGES

At the loan desk of the main library is kept a complete record of the books charged to individuals and to the various libraries and offices of the department. The increase in the number of books charged necessitated an addition of 12 drawers to the loan-desk cabinet containing the charge cards. This now numbers 66 drawers. It is estimated that they contain 56,500 cards. In many cases one card contains a charge for a whole file of a periodical or for several volumes of a work. The number of books charged is, therefore, probably between 60,000 and 70,000, or about one-third of the library's whole collection.

## REFERENCE WORK

The reference work in all branches of the library can not be measured in statistics which give no idea of the expert service rendered. A single inquiry may consume many hours of



time, but this may be far more fruitful of results than the circulation of a large number of volumes. Requests for aid in the search for information come in rapid succession and are received in person, by messenger, by telephone, and by letter. It is seldom that any two requests are alike, but it is a pleasure to add that the reference staff in the bureau libraries and in the main library is increasingly efficient in meeting the demands. Among the questions asked during the past year for which more or less satisfactory answers were found were the following, which may be considered typical: Efficiency of the farmers of to-day compared with the farmers of 10 years ago; efficiency of farmers in America compared with those in other countries; what the Federal Government has done for the farmers in the South; statistics of farm immigrants by countries of origin, 1892-1903; price fixing as embodied in pending farm relief bills; information on population as related to the food supply; references to agricultural sayings and proverbs of America; history of cotton ginneries in the South; history of futures exchanges; number of pounds of bananas in a bunch; changes in State boundary lines from 1790 to 1850; tomato industry in Italy; butter industry in Russia; commercial uses of insects; live steam as an insecticide; losses from insects; list of societies and journals dealing with parasitology; list with descriptions of the horticultural varieties of roses in the United States; who received the award of first prize for Kansas wheat at the World's Fair, 1893; information on the chinking of log cabins; what contagious diseases of cattle have been reported from New South Wales within the last six months.

These samples of reference questions asked could be extended indefinitely. There are also questions of other kinds which can best be answered by the directing of the inquiry to the office of the department where the definite information required may be obtained. Still another kind of question is that which after long and careful searching yields only a negative answer. Such questions are the least satisfactory, for to prove that certain information does not exist is a difficult matter in the present avalanche of printed matter.

### ACCESSIONS

The number of books, pamphlets, and maps added to the library during the

year by gift, purchase, and exchange was 15,215, an increase of 1,705 over last year. The detailed figures follow:

Purchases:	
Volumes .....	2,405
Pamphlets.....	239
Maps .....	12
Serials and continua- tions.....	626
Total .....	3,282
Gifts:	
Volumes .....	1,370
Pamphlets.....	964
Maps .....	72
Serials and continua- tions.....	5,887
Total .....	8,293
From binding periodicals and serials.....	3,394
New current periodicals.....	246
Total accessions.....	15,215

The amount of money spent for books, periodicals, serials, and maps is given in Appendix 3, page 11. Among the more important and valuable old books acquired were the following:

- Alamanni, Luigi.—*La coltivazione di Luigi Alamanni*. 1549.  
 Coler, Johann.—*Oeconomia rvralis et domestica*. 1645.  
 Dodoens, Rembert.—*Historia vitis vinique*. 1580.  
 Dugdale, Sir William.—*The history of imbanking*. 1662.  
 Durante, Castore.—*Herbario novo*. 1585.  
 Hill, John.—*The British herbal*. 1756.  
 Lawson, William.—*A new orchard and garden*. 1676.  
 Linné, Carl von.—*Genera plantarum*. Ed. 2. 1742.  
 Linné, Carl von.—*Wästgöta-Resa 'på riksens högföflige ständers befallning förordad år 1746*. 1747.  
 Macer Floridus.—*De herbarvm virtutibus*. [1530]  
 Markham, Gervase.—*Cheap and good husbandry*. 1683-84.  
 Merlet, Jean.—*L'abregé des bons fruits*. 4. ed. 1740.  
 Noisette, L. C.—*Catalogue général des arbres, arbustes et plantes*. 1826.  
 Periglis, Angelus de.—*Pervtilis et practicabilis tractatvs, de paleis et olivis*. 1550.  
 Philipps, Leonard.—*A catalogue of the exhibition of the collection of fruit trees*. [1790?]  
 Textor, Benedict.—*Stirpium differentiae ex Dioscoride*. 1537.  
 Theodorus, Jacobus.—*Neuw vollkommentlich kreuterbuch*. 1613.  
 Theophrastus.—*De historia, et cavis plantaru*. 1529.  
 Worlidge, John.—*Systema agriculturae*. Ed. 3. 1681.

Mention should also be made of 82 Thunberg dissertations and 22 Linnéan dissertations which were acquired. Among the notable recent books purchased were the following.

- The book of rural life. 1925. 10v.  
 Cosson, E. S. C. *Illustrationes florae Antianticae*. 2 v. 1882-97.  
 Dendrologische gesellschaft für Österreich-Ungarn. *Die gartenanlagen Österreich-Ungarns in wort und bild*. 2 v. 1909-14.

Phillips, J. C. Natural history of the ducks. v. 4. 1926.  
 Poynting, Frank. Eggs of British birds. 1895-96.  
 Schiøler, E. L. Danmarks fugle. v. 1. 1925.  
 Tornabene, Francisco. Flora sicula. 1887.  
 Walcott, M. V. North American wild flowers. v. 1. 1925.

Considerable progress was made during the year in the completion of the files of periodicals. Following is a list of some of the most important sets completed:

Acta Horti Petropolitani.  
 Archiv für wissenschaftliche und praktische tierheilkunde.  
 Archives de zoologie experimentale.  
 Bolezni rastenit.  
 Chicago daily trade bulletin.  
 Pharmaceutisches centralblatt.  
 La récolte dans la Russie d'Europe et d'Asie.  
 Société centrale d'horticulture. Annales.  
 Standard Poland-China record association.  
 Standard Poland-China record.

The library acquired by purchase the private library of the late B. H. Ransom, formerly Chief of the Zoological Division, Bureau of Animal Industry, which contained a number of rare zoological books and a valuable working collection of zoological pamphlets. The botanical books belonging to the late William E. Safford of the Bureau of Plant Industry were presented to the library by Mrs. Safford.

### CATALOGUING AND CLASSIFICATION

The record of the material classified and catalogued during the year was as follows:

Volumes.....	3,775
Pamphlets.....	1,203
Maps.....	84
Continuations and serials.....	6,517
Findery continuations.....	1,946
Binders.....	1,448
New current periodicals.....	246
Total.....	15,215

In addition to this material which was fully catalogued, author cards only were made for 2,215 "reprints" and 73 pamphlets. The amount of uncatalogued material on hand on July 1, 1926, which was considerably less than in the previous year, was as follows: Volumes, 892; pamphlets, 2,303; continuations, 493; maps, 15.

The number of titles prepared for printing by the Library of Congress in the "Agr." series was as follows: Accessions and recatalogued books, 1,603; department publications, 438; agricultural periodicals, 61; total, 2,102, an increase of 893 over the previous year.

The number of cards received from the Library of Congress was 2,065, an improvement over the previous year,

but there were still 171 manuscript cards on hand on July 1, 1926, waiting to be sent to the Library of Congress for printing, an accumulation of over two years because of the inability of the Library of Congress to keep pace with the preparation of the cards.

The number of cards added to the catalogue was 18,629. The cards withdrawn numbered 1,805, making a net addition of 16,824. The catalogue now contains more than a half million cards.

It is gratifying to record that the total amount of cataloguing done during the year was an increase over that of the previous year. This was due in large part to the acquisition of an expert typist for the typing of the catalogue cards and to the fact that there were fewer changes in the catalogue division.

In addition to the catalogues maintained by the main library, which include records of all the books belonging to the department, there are a number of extensive special-subject catalogues and indexes maintained by the various bureaus covering the special subjects in which they are particularly interested. These have had a normal increase during the year. Special mention should be made of the botanical indexes maintained by the Bureau of Plant Industry library which are located in the main library adjoining the main catalogue. The total number of cards added to these indexes during the year was 12,696.

### PERIODICALS

The record of current periodicals received by purchase, gift, and exchange was as follows:

Number of different periodicals received by purchase.....	1,094
Number of different periodicals received by gift and exchange.....	2,262
Total number of different periodicals received.....	3,356
Number of additional copies purchased.....	215
Number of additional copies received by gift and exchange.....	195
Total number of periodicals purchased, including duplicates.....	1,309
Total number of periodicals received by gift and exchange, including duplicates.....	2,457
Grand total of periodicals received, including duplicates.....	3,766

The number of annual reports, transactions, proceedings, and other serials of infrequent issue received in the past year in addition to the current periodicals was over 6,000.

Much time was spent during the past year in connection with the recording of our periodical holdings for the "Union list of serials" now being



compiled under the direction of a committee of the American Library Association. This union list, although not yet completed, has already been of great service in the reference work and in connection with the acquisition of serials by the library, as it shows what serials are now available in the libraries of the country. This information is of great value when deciding on the acquisition by this library of new sets or the completion of partial sets.

### BINDING

The number of books and periodicals sent to the Government Printing Office for binding was 3,104, an increase of 45 over the previous year. In addition to the books and periodicals permanently bound, 2,799 were laced in temporary binders and 1,397 current numbers of serials were added to files already in binders. The number of pamphlets stapled in binders was 945. The cost of binding is given in the financial statement, Appendix 3, on page 11.

### DUPLICATES

The library continued to receive a large number of duplicates, for the most part Government, State, and society publications which were sent to various offices of the department and later transferred to the library. Much time is required for the disposition of duplicates. Several lists were prepared during the year and sent to libraries and bookdealers. A large number of items were selected by the State agricultural college and experiment station libraries from lists included in "Agricultural library notes." The numbers selected by bookdealers realized an exchange value of \$216.35.

### EXCHANGES

During the year 1,485 orders were issued on the office of publications for the mailing of department publications which were requested by foreign institutions and officials and by societies and private individuals from whom publications are received in exchange. This was an increase of 190 orders over the previous year. There was no marked change in the foreign mailing lists, the number of addresses being about the same as last year.

### BIBLIOGRAPHICAL WORK

Two additions, Nos. 10 and 11, were made to the mimeographed series of Bibliographical contributions of the li-

brary. No. 10, entitled "Refrigeration and Cold Storage; a Selected List of References Covering the Years 1915-1924 and the Early Part of 1925," was prepared in the Bureau of Agricultural Economics library by Louise O. Bercaw, library assistant, and contains 58 pages. No. 11, entitled "List of Manuscript Bibliographies and Indexes in the United States Department of Agriculture, Including Serial Mimeographed Lists of Current Literature," was prepared in the library of the department by E. Lucy Ogden, bibliographical assistant, and Emma B. Hawks, associate librarian.

In the Bureau of Agricultural Economics library the following additions were made during the year to the mimeographed series of "Agricultural economics bibliographies":

- No. 7. Livestock financing. Compiled by Katharine Jacobs. 28 p.
- No. 8. The peach industry in the United States. Compiled by Louise O. Bercaw. 35 p.
- No. 9. Selected list of references on grain sorghums, grass sorghums, and broomcorn. Compiled by C. Louise Phillips, Grain Division. 9 p.
- No. 10. Research in rural economics and rural sociology in the Southern States since 1920. 44 p.
- No. 11. Economic periodicals of foreign countries published in the English language. Compiled by Louise O. Bercaw. 13 p.
- No. 12. Government control of export and import in foreign countries. Compiled by A. M. Hannay. 126 p.
- No. 13. Cooperative marketing of tobacco. Compiled by Katharine F. Williams, Division of Agricultural Cooperation. 5 p.
- No. 14. Factors affecting prices. Compiled by Louise O. Bercaw. 39 p.
- No. 15. Alabama: An index to State official sources of agricultural statistics. Compiled by Margaret T. Olcott. 96 p.
- No. 16. Periodicals relating to dairying received in the U. S. Department of Agriculture. Compiled by Muriel F. Wright. 20 p.

Special mention should be made of No. 15, the index to Alabama official sources of agricultural statistics. This is the first of a series of indexes to State agricultural statistics which has been undertaken in the Bureau of Agricultural Economics library in cooperation with the State agricultural college libraries and will be pushed as fast as circumstances permit. It lists the sources of statistics of all the agricultural commodities produced in Alabama, showing the years for which figures are available as well as the specific types of statistics which have been collected by the various State agencies.

In the Bureau of Chemistry library, the librarian, Louise Duvall, prepared



a list of "References for the study of the chemistry of the cotton plant and its products" which was included in the mimeographed publication of the main library entitled, "Agricultural Library Notes" for April, 1926 (vol. 1, No. 4, pp. 62-65).

In the Bureau of Dairying library the mimeographed list of available department publications relating to dairying was rewritten and revised three times by the librarian, Carrie B. Sherfy. The "Partial list of publications on dairying issued in the United States, 1900 to June, 1923," compiled by Miss Sherfy and issued in 1923 as Bibliographical Contribution No. 6, was reprinted as the supply had become entirely exhausted. There continues to be a steady demand for this list.

In the Bureau of Entomology the librarian, Mabel Colcord, issued an 11-page mimeographed list of the "Books often referred to in the correspondence of the Bureau of Entomology." The librarian also prepared the bibliography of the publications of the late W. D. Hunter of the Bureau of Entomology which was published in the Proceedings of the Entomological Society of Washington (Vol. 27, No. 9, pp. 176-181), December, 1925, in connection with the biography of Doctor Hunter by L. O. Howard. The librarian also has in preparation the next volume of the Index to American Economic Entomology.

The second biennial supplement of Department Bulletin 1199 entitled, "List of Bulletins of the Agricultural Experiment Stations" for the calendar years 1923 and 1924, prepared by the Office of Experiment Stations library, is now in press. This supplement contains an author index and a brief subject index to titles. The failure of the stations to send in their publications promptly, and also the extra work involved in preparing the index, caused the delay in the printing of the publication. Work on the third supplement for 1925 and 1926 is in progress, and it is expected that it will be printed before the end of 1927. "A selected list of references on extension work in the United States" has been prepared by the librarian, Cora L. Feldkamp, and it is hoped that this may later be mimeographed. There is also in preparation a list of circulars of the agricultural experiment stations. The librarian of the office continued to prepare the mimeographed monthly list of agricultural extension publications of the various States.

In the Forest Service library the "Complete list of Forest Service publications" was revised this year by the librarian, Helen E. Stockbridge, to include everything issued up to December 1, 1925, and the selected list of "Books on forestry in English" was enlarged and mimeographed on February 1, 1926. The latter was published in the 1926 edition of the Forestry Almanac issued by the American Tree Association. The following subjects have been covered by short bibliographies during the year: Balsa wood, brush disposal, communal forests, famous trees, forest ecology, forest surveys, game in the national forests, swamps and swamp vegetation. The library continued to issue a monthly list of the books and periodicals indexed which is still published in the Journal of Forestry.

In the Bureau of Home Economics library a bibliography on footwear by the librarian, Mrs. E. T. Shively, is nearly completed. The librarian has also begun work on the bibliographical history of the bureau. This will include publications of the nutrition investigations of the Office of Experiment Stations, 1894-1915; publications of the Office of Home Economics, 1915-1923; and of the Bureau of Home Economics, 1923 to date.

In the Bureau of Plant Industry library the most important bibliographical undertaking was the new list "Agronomy—Current Literature," prepared by Jessie M. Allen, librarian. This list was started as an attempt to meet a demand for the extension of the service supplied by the botanical list. The list includes articles on agronomy appearing in current journals, transactions and reports received in the department library, also books and experiment station literature on the subject. The distribution at present is mostly to the bureau workers in Washington and in the field. Owing to the fact that the subject of agronomy is not definitely limited and more or less overlaps applied botany, it has been difficult to set limits for the material covered. The list is believed to be a step in the direction of supplying a needed service, but some change in its form may later be advisable. To conform to the title of the agronomy list, the botanical list which had been issued under the title "Current Botanical Literature" since January, 1925, was changed in April, 1926, to "Botany—Current Literature." The circulation of this list, which is prepared by Alice C. Atwood, bibliographical assistant, Bureau of

Plant Industry, and her assistant, Esther M. Colvin, has increased during the year from 480 to 570 copies. The increase was due partly to the agronomy list which brought the service to the attention of the agronomists in need of literature on both subjects.

The librarian of the Bureau of Public Roads, O. Louise Evans, has assisted in the editing of a bibliography relating to soil moisture and the movement of moisture in soils, to be published as a department bulletin. The mimeographed list of contents of new periodicals to which is appended a list of new accessions, has been issued regularly by the bureau library each week.

The librarian of the department prepared a list of "References on bibliographic style in literature citations," which was issued in "Agricultural Library Notes" for March, 1926 (Vol. 1, No. 3, p. 37-40). The list was prepared in connection with a lecture on the subject of "Bibliographies and bibliographic citations" in the course on bulletin writing given in the department under the direction of M. C. Merrill, editorial chief of publications.

In addition to the more important bibliographies mentioned in the paragraphs above, many brief lists on various subjects were prepared both in the main library and the bureau libraries in response to requests received in correspondence.

## BUREAU AND DIVISION LIBRARIES

A list of the bureau and division libraries and the statistical data in regard to them will be found on page 10, Appendix 2. An account of the bibliographical work is given under the heading "bibliographical work" on pages 5-7. The statistics of the circulation in the bureau libraries are given in the tables in Appendix 1.

## WORK OF THE YEAR

In the Bureau of Agricultural Economics library the outstanding feature of the year's work was the increase in the amount of bibliographical and reference work performed and the increase in the demand for this work. The requests from outside of the department come from many different agencies and institutions, such as chambers of commerce, statistical bureaus, appraisal companies, insurance companies, stockyards, railroads, lighting plants, map workers, manufacturing companies, cold storage companies, Federal reserve and other

banks, and various other kinds of organizations.

In the Bureau of Animal Industry library the assistant librarian, Elizabeth C. Walton, resigned in March, 1926. The vacancy has been filled by the appointment of Charlotte Sprenkel.

The Bureau of Chemistry library suffered a severe loss in the death of Louise Duvall, who had served the bureau as librarian since May 19, 1920, and for several years previously as assistant librarian. Her long connection with the bureau, her familiarity with its work and policies, and her knowledge of chemical literature, combined to give high value to her services.

In the Bureau of Dairying library an effort was made during the past year to make the workers of the bureau more familiar with the resources of the main library. The librarian of the bureau arranged for about two dozen workers on the scientific staff to visit the main library in three separate groups. They were conducted through the library, the classification and catalogues were explained to them, and their attention was called to reference books which it was thought would be of particular interest.

The librarian of the Bureau of Dairying has charge of the photographic and correspondence files in addition to the library work. It was necessary to devote considerable time during the year to the revision of the classification system for photographs.

In the Bureau of Entomology library several foreign visitors spent considerable time during the year. Stepan Soudek, assistant professor of zoology, University of Brno, Czechoslovakia, and V. V. Nikolsky, of the Moscow Tropical Institute, each spent two months working in the library, and Nils Vappula, of the Agricultural Institute of Finland, spent six weeks in the library. Other foreign visitors were Kota Monzen, of the Imperial College of Agriculture and Forestry, Morioka, Japan, and Jorge Malottsky, N. Escobar, jr., and R. Escobar, from Mexico.

The Office of Experiment Stations sustained a serious loss in the resignation of the librarian, Martha L. Gericke, who had been connected with the library for a number of years. Miss Gericke resigned January 15, 1926, to accept the position of librarian of the State Department. She was succeeded by Cora L. Feldkamp, who has been in the Office of Experiment Stations library for several years and previously had been librarian of the office of farm management.



To relieve the Forest Service library of some of its routine work the records of all field libraries charged to the western district foresters, national forests, and experiment stations were transferred last fall to the district offices concerned. The Forest Service library still keeps the records of books in the forest products laboratory and the eastern national forests and experiment stations. A small library is to be maintained for a few years at New Haven for the use of the recently authorized forest taxation inquiry under Professor Fairchild, of Yale University.

The Bureau of Public Roads library was moved in March, 1926, from the eighth floor to a much more convenient and desirable location on the first floor of the building occupied by the bureau. The library was also given additional space and additional shelving sufficient to bring together the collections belonging to the library which were previously scattered in different rooms and corridors. The assistant librarian of the bureau, Hazel B. MacDonald, resigned in November, 1925, to accept the position of librarian of the transportation library at the University of Michigan. The vacancy was filled by the transfer of Mrs. Dorothy J. Wilks from the Bureau of Plant Industry library.

#### COOPERATION WITH THE STATE AGRICULTURAL COLLEGE AND EXPERIMENT STATION LIBRARIES

The close relationship between the land-grant colleges and experiment stations and this department is well known. A glance at the publications of the department will show that in recent years the number of cooperative undertakings on the part of the States and the department has been steadily increasing. In the same spirit of cooperation and with a realizing sense of their common interests the libraries of the State agricultural colleges and experiment stations and the library of the department are being yearly brought into closer relationship through the meetings of the agricultural libraries section of the American Library Association. At the last meeting of the section in July, 1925, the need for indexes to the agricultural statistics of the various States was discussed. The librarian of the Bureau of Agricultural Economics, who was chairman of the section last year, explained that preliminary steps had been taken by her library in preparation for beginning a series of such indexes. This

statement aroused much interest on the part of the librarians who were present and in the discussion which followed it was decided that such cooperation as was possible should be given by the agricultural libraries of the various States. As a result of this discussion a promising beginning has been made during the past year in the definite sharing of labor with the State agricultural college libraries in the compilation of bibliographies of common interest. An arrangement has recently been consummated between the Bureau of Agricultural Economics library and the Oklahoma Agricultural and Mechanical College, in accordance with which two of the assistants from the latter library are to come to the Bureau of Agricultural Economics library for an aggregate period of three months during the summer of 1926 to compile an index of the State official sources of agricultural statistics of Oklahoma. Several other States are considering similar arrangements. The index to the state official sources of agricultural statistics of Alabama which was prepared by the Bureau of Agricultural Economics library during the past year is being used as a model for the indexes for other States.

In the efforts toward cooperation between the agricultural libraries, the need has been felt for some time of a medium of communication. At the meeting of the agricultural libraries section of the American Library Association last year a definite recommendation was made that this library be asked to issue, in cooperation with the State agricultural libraries, mimeographed lists giving news notes on reading lists and bibliographies prepared by agricultural libraries, notes of new publications which might not otherwise come to the attention of the individual agricultural libraries, and lists of new mimeographed material of the department. It was to meet these needs and requests that a monthly mimeographed publication entitled, "Agricultural Library Notes," was inaugurated by the library in January, 1926, in cooperation with the State agricultural libraries.

In continuation of the library's policy of giving opportunities to librarians and assistants connected with the State agricultural colleges and experiment stations to have experience in this library, arrangements were made last fall for the librarian of the Florida Agricultural Experiment Station to spend two weeks in this library in order to become more familiar with its resources and catalogs.



### LIBRARY STAFF

The number of permanent employees carried on the staff of the main library at the close of the fiscal year was 34, a decrease of 2 as compared with 1925. The number employed by the bureau and office libraries was 52, the same as last year. The total number permanently employed in the main library and the bureau and office libraries was 86, distributed as follows: 14 in administrative positions, including the librarian of the department, the heads of divisions in the main library, and the librarians of the bureaus; 37 assistant librarians, junior librarians, library assistants, and junior library assistants; 12 under and minor library assistants; 13 clerical assistants; 1 translator; 6 messengers; and 3 charwomen. In the main library the work suffered from an unusually large number of changes during the year. Ten resigned to accept other positions, but of these, two went to bureau libraries and therefore are still in the library service of the department. Reference has previously been made to the death of Louise Duval, Librarian of the Bureau of Chemistry. In addition, a recently appointed assistant in the main library, Muriel T. Tierney, was lost by death.

Staff meetings, including the staffs of both the main library and the bureau libraries, were held each month from October to June.

### FINANCES

The receipts and expenditures of the library for the past year are given in Appendix 3, page 11. In connection

with the salaries which have been carried for the library by the bureaus for the last seven years, it is most gratifying to be able to record the fact that provision for these was included in the library appropriation for the fiscal year 1927. It will not, therefore, be necessary to call on the bureaus for help in carrying salaries during the current fiscal year, but an increase in the staff for the fiscal year 1928 is urgently needed, particularly in connection with the cataloguing.

### LIBRARY QUARTERS

The passage of the public buildings act and the expected assignment of several millions of dollars to the Department of Agriculture for its building program give reason for the hope that new and permanent quarters for the library may soon be provided which will be adequate and suitable for its special needs. Although 4,313 square feet of additional space were granted to the library in 1923 for book stacks, this space has been rapidly filled and the shelves are again becoming badly crowded. Even if the erection of the buildings is hastened, it is feared that the congestion of the library shelves will be serious before the new quarters for the library can be available. The importance of the library service in the work of the department and the inestimable value of its extensive collections, which could not be replaced, urgently demand that the library's needs be given primary consideration in the plans for the new buildings.

## APPENDIX 1

### Combined statistics of circulation

Bureau or office library	To individuals	To main library	To branch libraries	Total	Periodicals
Main library.....	20,098	-----	25,518	46,618	(1)
Bureau of Agricultural Economics.....	14,587	1,977	-----	16,564	185,360
Bureau of Animal Industry.....	2,062	196	63	2,321	29,622
Bureau of Chemistry.....	7,445	914	35	8,395	28,514
Bureau of Dairying.....	2,327	95	-----	2,422	17,995
Bureau of Entomology.....	2,990	568	-----	3,498	3,493
Office of Experiment Stations.....	(2)	(2)	(2)	(2)	(2)
Forest Service.....	2,197	428	-----	2,625	8,420
Bureau of Home Economics.....	(3)	(3)	(3)	3,060	6,084
Bureau of Plant Industry.....	(4)	(1)	(1)	(4)	43,188
Bureau of Public Roads.....	3,085	249	-----	3,334	15,890
Total.....	54,791	4,367	25,616	-----	338,566

<sup>1</sup> No record of the circulation of periodicals is kept in the main library for the whole year, but it is kept for one month each year.

<sup>2</sup> No exact circulation figures are available for the Office of Experiment Stations. The circulation is, however, large, as the office, in connection with the work of the experiment stations, receives all new books and periodicals which are needed for review and abstracting; 950 periodicals are regularly circulated and many more specially requested. The circulation is estimated to be not less than 50,000.

<sup>3</sup> Figures not available.

<sup>4</sup> The Bureau of Plant Industry library does not maintain a collection of books, as it is in close proximity to the main library. The circulation of books to members of the bureau is, therefore, included with those for the main library but circulation figures are available for current periodicals, as this circulation is handled in the Bureau of Plant Industry library.

## APPENDIX 2

### Bureau libraries

Bureau or office	Number employed	Number of books	Number of pamphlets	Number of periodicals currently received	Number of registered borrowers	Number of registered borrowers to whom periodicals are circulated
Bureau of Agricultural Economics.....	<sup>1</sup> 15	<sup>2</sup> 25,000	(3)	1,667	396	<sup>4</sup> 124
Bureau of Animal Industry.....	2	-----	(3)	(3)	(3)	86
Animal Husbandry Division.....	1	<sup>2</sup> 3,800	<sup>2</sup> 2,800	<sup>2</sup> 260	<sup>2</sup> 50	-----
Bureau of Chemistry.....	4	9,386	(3)	478	284	134
Bureau of Dairying.....	4	590	<sup>2</sup> 4,650	365	60	57
Bureau of Entomology.....	3	9,751	11,200	905	206	20
Office of Experiment Stations.....	<sup>1</sup> 8	<sup>2</sup> 3,800	53,977	<sup>2</sup> 925	78	78
Forest Service.....	1	<sup>5</sup> 25,335	(3)	<sup>2</sup> 178	146	71
Bureau of Home Economics.....	1	(3)	(3)	262	(3)	(3)
Bureau of Plant Industry.....	<sup>1</sup> 10	<sup>2</sup> 600	<sup>2</sup> 1,100	900	(6)	167
Bureau of Public Roads.....	3	<sup>2</sup> 5,130	<sup>2</sup> 9,452	304	151	94

<sup>1</sup> Including messenger.

<sup>2</sup> Approximate figures.

<sup>3</sup> Figures not available.

<sup>4</sup> Offices.

<sup>5</sup> Books and pamphlets.

<sup>6</sup> Book circulation handled in main library.

## APPENDIX 3

*Financial statement*

## RECEIPTS

## Source:

Library appropriation—	
Statutory salaries-----	\$38,680.00
General expenses-----	29,500.00
Total-----	68,180.00
Main library salaries paid by bureaus-----	16,521.50
From department printing and binding fund-----	9,983.30
Grand total-----	94,684.80

## EXPENDITURES

Books and serials-----	<sup>1</sup> 14,093.95
Periodicals-----	7,121.39
Index cards-----	169.30
Furniture, shelving, and miscellaneous equipment-----	<sup>2</sup> 404.77
Freight, express, and drayage-----	41.42
Supplies and repairs-----	<sup>3</sup> 971.84
Truck service-----	85.80
Newspapers-----	99.60
Salaries (statutory)-----	38,617.80
Salaries (miscellaneous)-----	5,080.00
Total-----	66,685.87
Printing-----	<sup>4</sup> 477.32
Binding-----	<sup>4</sup> 9,505.98
Main library salaries paid by bureaus-----	16,521.50
Grand total-----	93,190.67
Credit received for duplicates exchanged with book dealers and libraries----	216.35

<sup>1</sup> Outstanding liabilities for books, periodicals, and serials, \$1,419.31.<sup>2</sup> Itemized as follows:

Office furniture and equipment-----	207.29
Steel shelving-----	42.40
Floor covering-----	98.10
Wooden cases-----	56.98

Total-----404.77

<sup>3</sup> Itemized as follows:

Supplies:	
Cleaning and toilet supplies-----	109.31
Binding material and paste-----	73.10
Miscellaneous office supplies-----	291.99

Total-----474.40

Repairs and alterations:

Carpentry work-----	151.52
Electrical work-----	45.52
Typewriting repairs-----	86.58
Miscellaneous repairs-----	46.64

Total-----497.44

<sup>4</sup> Itemized as follows:

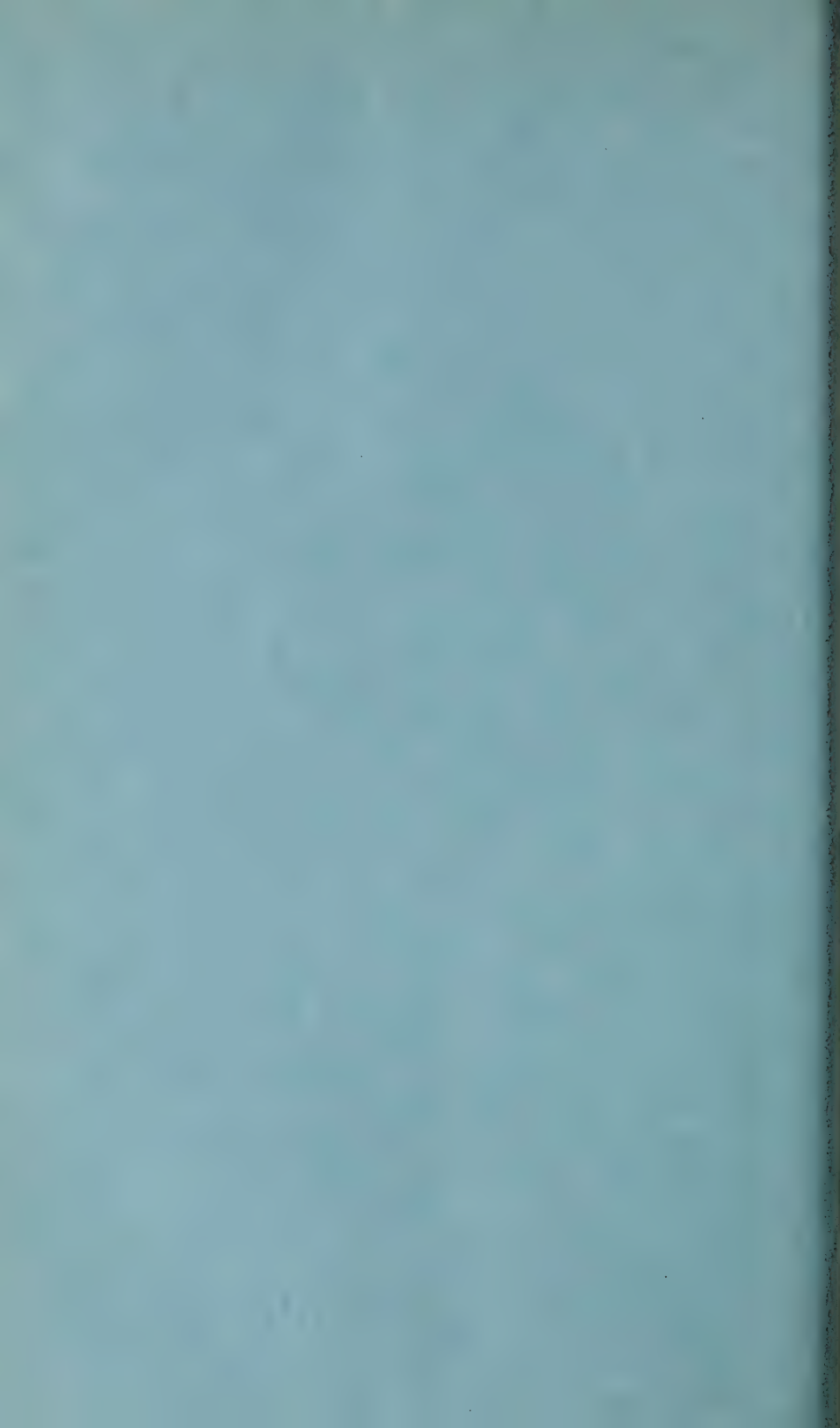
Regular binding-----	7,999.14
Binders-----	1,445.77
Pamphlet boxes-----	61.07
Forms-----	304.32
Publications-----	173.00

Total-----9,983.30











JUN 15 1926

EXPERIMENT STATION FILE

File Bureau Repts  
1926

UNITED STATES DEPARTMENT OF AGRICULTURE  
OFFICE OF THE SECRETARY

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**Report of  
The Packers and Stockyards  
Administration**

**From July 1, 1924 to March 30, 1926**



WASHINGTON  
GOVERNMENT PRINTING OFFICE

1926

THE UNIVERSITY OF CHICAGO  
LIBRARY

THE UNIVERSITY OF CHICAGO  
LIBRARY

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# REPORT OF THE PACKERS AND STOCKYARDS ADMINISTRATION

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
PACKERS AND STOCKYARDS ADMINISTRATION,

*Washington, D. C., March 30, 1926.*

SIR: I have the honor to submit herewith a report of the Packers and Stockyards Administration for the period since June 30, 1924, to the present date.

This report was prepared in accordance with the terms of Senate Resolution 145, adopted February 16, 1926, and embraces subjects heretofore included within the annual reports of the administration of the packers and stockyards act, and in addition gives the information specifically called for by the resolution.

It is recommended that this report be published, and that copies thereof be furnished to the Congress in accordance with the resolution.

Respectfully,

JOHN T. CAINE, *Chief.*

Hon. W. M. JARDINE,  
*Secretary of Agriculture.*

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This report, covering the activities of the Packers and Stockyards Administration since June 30, 1924, is prepared and published in response to a resolution of the Senate of the United States adopted February 16, 1926 (Senate Resolution No. 145), copy of which was duly transmitted to the Secretary of Agriculture by the Secretary of the Senate under date of February 16, 1926. This resolution reads as follows:

Whereas it appears that there has been no published report of the administration of the packers and stockyards act, 1921, for the fiscal year ended June 30, 1925, or since then, comprehensively covering the subjects embraced within the published annual reports of the administration of said act for prior years; and

Whereas the American National Livestock Association has requested information concerning the administration and enforcement of said act; and

Whereas Members of the House and Senate are in receipt of other requests for such information, which they are unable to supply: Therefore be it

*Resolved*, That the Secretary of Agriculture be requested, if not incompatible with the public interest, to cause the preparation and publication as soon as possible of a comprehensive report, and to furnish copies thereof to the Congress, covering in said report for the period which has elapsed since June 30, 1924, the subjects embraced within the annual reports of the administration of the packers and stockyards act, 1921, which have heretofore been published, including among other things—

(a) A description of the present organization for the administration and enforcement of said act.

(b) What progress has been made in obtaining information and what facts have been ascertained from the packers subject to said act, through reports and through audits of their books, and the present status of any litigation instituted to determine the right of the Secretary of Agriculture to have access to such books.

(c) The volume of business done at public stockyard markets subject to said act and the extent to which it has increased or decreased; and the volume together with the increase or decrease of business done by cooperative market agencies engaged in the livestock commission business at such markets as compared with all other market agencies in such business at such markets.

(d) Whether the rates and charges of market agencies and stockyard owners subject to said act have increased or decreased, and what steps have been taken to investigate or regulate such rates and charges, including a report of the formal proceedings pending, together with those which have been terminated and the reason for such action.

(e) What steps have been taken and what results have been obtained in investigating and bringing about the cessation of discriminatory and unfair or otherwise unlawful practices on the part of persons subject to said act, including a report of the formal proceedings pending, together with those which have been terminated and the reasons for such action.

(f) What, if any, changes in said act are considered desirable in the light of the practical experience gained in its administration and enforcement.

The packers and stockyards act, 1921, was passed by Congress and approved by the President on August 15, 1921. Prior to the period covered in this report there had been published three annual reports giving a compre-



hensive outline of the activities connected with the enforcement of this law.

## PRESENT ORGANIZATION

### WASHINGTON OFFICE

The activities of the Packers and Stockyards Administration in the enforcement of the act fall logically into several branches according to subject matter. For convenience and efficiency in operation, separate divisions have been organized to handle these different branches and include: Audits and accounts, rates and registrations, and trade practices.

This is a considerable change from the organization outlined in previous reports. There is no longer maintained a separate administrative division. Also the division of economics has been eliminated, and its work is now being handled by specialists in other divisions in cooperation with the Bureau of Agricultural Economics.

The division of audits and accounts handles all matters pertaining to reports and special audits of the business of the agencies subject to the act. The division is in charge of the general auditor, who has several assistants and the necessary clerical force for tabulating reports.

The rates and registrations and trade practices divisions were created June 1, 1925, by dividing the work which was previously assigned to the division of rates and practices. The division of trade practices is responsible for formulating general policies arising in connection with market practices. Matters of policy, as well as the more difficult problems arising at markets, are usually referred to this division for advice and assistance. The division also handles the work incident to the proper testing and maintenance of livestock scales. Two competent scale men are engaged on this work.

The division of rates and registrations records the registrations of all market agencies and dealers and reviews the bonds required under the regulations. It also handles rate schedules filed by market agencies and stockyard companies. Changes in rates are carefully checked to determine whether they are justified and whether the schedules otherwise comply with the act. Data are prepared upon the basis of which recommendations may be made to the Secretary as to appropriate action on rate changes. Three engineers are employed in making inventories and valuations of stockyard property devoted to stockyard services.

Each division has several assistants who specialize in some particular phase of the work.

The law division, with its personnel, was transferred to the solicitor's office on June 1, 1925.

### FIELD FORCE

There are three divisions of the field organization, with headquarters as follows: Eastern at Cleveland; central at Kansas City, and western at Denver. The northern division, with headquarters at Chicago, was discontinued August 1, 1925, and the markets which were included within it were distributed among the other divisions, the central being extended to include those in Illinois and Wisconsin, the western to include those in Texas and Oklahoma, and the eastern to take in the remaining markets. A further intensive study of the field organization is now being made and as a result it is probable that further changes will be made, if possible, with a view to bringing the field men in more direct touch with the Washington office.

Under the plan put into effect in August, 1925, the auditors and accountants were given permanent locations at a number of the leading markets. Previously, most of them did not have permanent assignments, but were shifted from one market to another, wherever the occasion demanded their services. The present plan adds materially to the efficiency of the staff in that each auditor becomes more familiar with the conditions and trade in his district and the amount of travel is reduced.

Representatives of the Packers and Stockyards Administration are located at:

Washington, D. C., 1316 B Street SW., supervises Baltimore, Md., Benning, D. C., and Richmond, Va.

Buffalo stockyards, 27 Livestock Exchange Building, supervises Detroit, Mich., Fostoria, Marion, and Toledo, Ohio.

Chicago Union Stockyards, 999 Exchange Avenue, supervises Galesburg and Peoria, Ill., and Milwaukee, Wis.

Cincinnati Union Stockyards, 9 Livestock Exchange Building, supervises Columbus, Dayton, and Springfield, Ohio, and Louisville, Ky.

Cleveland Union Stockyards, 29 Livestock Exchange Building.

Denver Union Stockyards, 414 Livestock Exchange Building, supervises Ogden and Salt Lake City, Utah, and Pueblo, Colo.

Fort Worth Stockyards, 233 Livestock Exchange Building, supervises Amarillo, Dallas, El Paso, Laredo, and San Antonio, Tex., and Oklahoma City, Okla.

Indianapolis Belt Railroad and Stockyards, 238 Livestock Exchange Building, supervises Evansville, Fort Wayne, Lafayette, and Muncie, Ind.

Kansas City Stockyards, 923 Livestock Exchange Building, supervises Springfield, Mo.

Los Angeles Union Stockyards, 207 Livestock Exchange Building, supervises San Francisco, Calif.

Nashville Union Stockyards, 214 Livestock Exchange Building, supervises Arabi, La., Atlanta, Augusta, and Moultrie, Ga., Chattanooga, Knoxville, and Memphis, Tenn., Columbia, S. C., Jacksonville, Fla., and Montgomery, Ala.

New York Stockyards, 348 West Fourteenth Street, supervises Albany, N. Y., Boston, Mass., Lancaster and Philadelphia, Pa., and Jersey City and Newark, N. J.

Omaha Union Stockyards, 320 Livestock Exchange Building.

Pittsburgh Union Stockyards, 315 Livestock Exchange Building.

Portland Union Stock Yards, 106 Livestock Exchange Building, North Portland, Oreg., supervises Pasco, Seattle, and Spokane, Wash.

Sioux City Stockyards, 322 Livestock Exchange Building, supervises Sioux Falls, S. Dak.

St. Joseph Stockyards, 415 Livestock Exchange Building, South St. Joseph, Mo.

St. Louis National Stockyards, 58 Livestock Exchange Building, National Stock Yards, Ill., supervises Springfield, Ill.

St. Paul Union Stockyards, 530 Livestock Exchange Building, South St. Paul, Minn.

Wichita Union Stockyards, 45 Livestock Exchange Building.

#### PERSONS SUBJECT TO THE ACT

##### STOCKYARDS

At the present time there are 77 stockyards subject to the act, a list of which follows:

Name of yards	City	Date posted
Western Stockyards Co.	Amarillo, Tex.	July 1, 1922
New Orleans Stock Yards (Inc.)	Arabi, La.	Nov. 1, 1921
Atlanta Union Stock Yards	Atlanta, Ga.	Do.
J. W. Patterson Commission Co.	do.	Apr. 1, 1922
J. K. Shippey & Bros.	do.	Apr. 30, 1924
Augusta Stock Yard Co.	Augusta, Ga.	Nov. 1, 1921
Union Stock Yard Co.	Baltimore, Md.	Do.
Union Stock Yard Co. of N. J.	Benning, D. C.	Do.
Brighton Stock Yards Co.	Brighton, Mass.	Do.
The Buffalo Stock Yards	Buffalo, N. Y.	Do.
Foust-Yarnell Stock Yards	Chattanooga, Tenn.	Do.
Union Stock Yard & Transit Co. of Chicago	Chicago, Ill.	Do.
Cincinnati Union Stock Yard Co.	Cincinnati, Ohio	Do.
Cleveland Union Stock Yards Co.	Cleveland, Ohio	Do.
Columbia Stock Yards	Columbia, S. C.	Do.
Drovers Union Stock Yards	Columbus, Ohio	Do.
Dallas Union Stock Yards Co.	Dallas, Tex.	July 1, 1922
Union Stock Yards Co.	Dayton, Ohio	Nov. 1, 1921
Denver Union Stock Yards Co.	Denver, Colo.	Do.
The Detroit Stock Yards	Detroit, Mich.	Do.
El Paso Union Stock Yards Co.	El Paso, Tex.	Do.
Independent Stock Yards	do.	Do.
Evansville Union Stock Yard Co.	Evansville, Ind.	Do.
Fort Wayne Union Stock Yards Co.	Fort Wayne, Ind.	July 1, 1922
Fort Worth Stock Yards Co.	Fort Worth, Tex.	Nov. 1, 1921
Fostoria Union Stock Yards Co.	Fostoria, Ohio	Do.
Galesburg Horse & Mule Co. (Inc.)	Galesburg, Ill.	Apr. 16, 1925
Belt Railroad and Stock Yards Co.	Indianapolis, Ind.	Nov. 1, 1921
National Stock Yards	Jacksonville, Fla.	Do.
The Jersey City Stock Yards Co.	Jersey City, N. J.	Do.
Kansas City Stock Yards Co.	Kansas City, Mo.	Do.
East Tennessee Stock Yards	Knoxville, Tenn.	Do.
Lafayette Union Stock Yard Co.	Lafayette, Ind.	Do.
Union Stock Yard Co.	Lancaster, Pa.	Do.
Union Stock Yards	Laredo, Tex.	Dec. 1, 1922
Los Angeles Union Stock Yards Co.	Los Angeles, Calif.	Nov. 1, 1922
Bourbon Stock Yard Co.	Louisville, Ky.	Nov. 1, 1921
Marion Union Stock Yards Co.	Marion, Ohio	Do.
Memphis Union Stock Yards	Memphis, Tenn.	Do.
Darnell Stockyards	do.	Apr. 1, 1924
Dixie-National Stock Yards (Inc.)	do.	Nov. 1, 1921
South Memphis Stock Yards	do.	Do.
Milwaukee Stock Yards Co.	Milwaukee, Wis.	Do.
Union Stock Yards Co. of Montgomery (Inc.)	Montgomery, Ala.	Do.
Southern Stock Yards	Moultrie, Ga.	Do.



Name of yards	City	Date posted
Farmers National Stockyards	Muncie, Ind.	Mar. 5, 1924
Nashville Union Stock Yards (Inc.)	Nashville, Tenn.	Nov. 1, 1921
St. Louis National Stock Yards	National Stock Yards, Ill.	Do.
Newark Stock Yards	Newark, N. J.	Do.
New York Stock Yards Co.	New York, N. Y.	Do.
Portland Union Stock Yards Co.	North Portland, Ore.	Do.
Salt Lake Union Stock Yards	North Salt Lake, Utah.	Do.
Union Stock Yards	Ogden, Utah.	Do.
Oklahoma National Stock Yards Co.	Oklahoma City, Okla.	Do.
Pasco Union Stock Yards Co.	Pasco, Wash.	Do.
Peoria Union Stock Yards Co. (Inc.)	Peoria, Ill.	Do.
West Philadelphia Stock Yard Co.	Philadelphia, Pa.	Do.
Pittsburgh Union Stock Yards Co.	Pittsburgh, Pa.	Do.
Pueblo Stock Yards Co.	Pueblo, Colo.	Mar. 1, 1922
Richmond Union Stock Yards Co.	Richmond, Va.	Oct. 31, 1921
Southern Stock Yards Corp.	do.	Do.
Union Stock Yards, S. A.	San Antonio, Tex.	Nov. 1, 1921
Union Stock Yards, Butchertown Reservation	San Francisco, Calif.	Dec. 3, 1923
Union Stock Yards Co., of Seattle	Seattle, Wash.	Nov. 1, 1921
Sioux City Stock Yards Co.	Sioux City, Iowa	Do.
Sioux Falls Stock Yards Co.	Sioux Falls, S. D.	Do.
Union Stockyards Co. of Omaha (Ltd.)	South Omaha, Nebr.	Do.
St. Joseph Stock Yards Co.	South St. Joseph, Mo.	Do.
St. Paul Union Stockyards Co.	South St. Paul, Minn.	Do.
Spokane Union Stock Yards Co.	Spokane, Wash.	Do.
Springfield Stock Yards	Springfield, Ill.	Feb. 11, 1926
Springfield Stockyards Co.	Springfield, Mo.	Dec. 3, 1925
Springfield Union Stock Yards Co.	Springfield, Ohio	Nov. 1, 1921
Inter-State Stock Yards Co.	Toledo, Ohio.	Do.
Toledo Union Stock Yards Co.	do.	Do.
New York Central Stock Yards	West Albany, N. Y.	Do.
Wichita Union Stock Yards Co.	Wichita, Kans.	Do.

Since July 1, 1924, the following stockyards have been posted:

Galesburg Horse & Mule Co (Inc.),  
Galesburg, Ill.

Springfield Stockyards Co., Spring-  
field, Mo.

Springfield Stockyards, Springfield,  
Ill.

The following three yards were  
released from jurisdiction:

Pursley Stockyards, Chattanooga,  
Tenn.

Union Stockyard Co., Norfolk, Va.

Union Stockyards, Roanoke, Va.

Several stockyards were examined  
and found not to come within the  
definition of a "stockyard" as defined  
in the act, located at the following  
places:

Calumet, Ill.	Huron, S. Dak.
Cheyenne, Wyo.	Lexington, Ky.
Connellsville, Pa.	Meridian, Miss.
Cynthiana, Ky.	Mount Sterling, Ky.
Dallas Center, Iowa.	Urbana, Ohio.
Danville, Ky.	Wheeling, W. Va.

At the present time a general investi-  
gation is being made of the horse and  
mule markets for the purpose of getting  
all the information in regard to their  
operations, so that it may be deter-  
mined whether they come within the  
definition of a "stockyard" and should  
be posted.

#### MARKET AGENCIES AND DEALERS

On July 1, 1925, there were 5,653  
market agencies and dealers registered.

Since July 1, 1924, registrations have  
been received from 399 market agencies.  
During the same period the registra-  
tions of 311 market agencies were  
rendered inactive. These changes were  
due chiefly to retirement from the  
markets and reorganizations of com-  
mission firms. During the fiscal year  
ended June 30, 1925, registrations were  
received from 769 dealers, and the reg-  
istrations of 578 were rendered inac-  
tive. It is not possible to give the  
changes in the registration of dealers  
since that time as the list of registered  
dealers has been in process of revision.  
An opinion was rendered by the solicitor  
to the effect that the law did not require  
the registration of the employees of  
registered dealers who were engaged in  
buying or selling livestock. It was  
held that the registration of the prin-  
cipal was sufficient. The previous  
registrations had been effected in  
accordance with a literal interpretation  
of the act, which defines a dealer as  
"any person, not a market agency,  
engaged in the business of buying or  
selling in commerce livestock at a  
stockyard, either on his own account  
or as the employee or agent of the



vendor or purchaser." In this opinion it was further held that a market agency engaged in the business of a dealer should register not only as a market agency but also as a dealer. The registrations of market agencies had been effected to show on their registrations all of their activities, but on the records they were designated merely as market agencies, even though the registration showed that they were engaged in the activities of a dealer in addition to those of a market agency. As a result of this ruling it has been necessary to make considerable change in the list of dealers, and it will be some time before a new list will be complete.

#### PACKERS

The number of packers coming within the meaning of the term "packer," as defined in the act, can only be approximated at this time, due to the various factors to be considered in determining this question. The administration has been engaged for some time in a study of the operations of those engaged in the packing business and allied activities for the purpose of securing a more comprehensive list of the packers subject to the act. Reports were received from 525 packers for the year 1924. The reports for 1925 have not all been received.

#### TRADE PRACTICES

Questions of general policy are determined at Washington, but the major part of the effective supervisory work is done by the supervisors stationed at the leading markets. They are men selected by reason of their practical knowledge of marketing conditions and problems and their ability and initiative in adjusting local difficulties. Irregularities which are not of serious consequence or do not indicate a practice which is inherently detrimental to the shipper are adjusted by the supervisor, with the approval of the Washington office, without formal proceedings. Cases other than these are referred to Washington for the institution of formal proceedings authorized by the act.

In determining whether the act is being complied with, two general avenues are open to the supervisor: (1) His personal observation of the daily physical operations in the yards and (2) an audit of the books and records of the market agencies, stockyard owners and dealers. The audit is made by the accountants, who submit to the supervisor a complete report

of apparent irregularities. The report is considered by the supervisor, who forwards it to Washington with his recommendations. If the matter is such that formal proceedings are not required the supervisor is authorized to adjust it informally. A large number of citations have issued on such reports, alleging violations either of the rules filed by the market agencies or the provisions of the act. These resulted either in admissions on the part of those charged or the issuance of cease and desist orders upon the evidence adduced at hearings. Many of the cases involved discrepancies in price or weight of livestock. In some it was found upon a hearing or further investigation that the alleged violations were more apparent than real and that the discrepancies were merely errors and did not involve the violation of the act or the regulations of the Secretary. Under the present plan the supervisor is authorized to adjust such cases informally. The action taken since July 1, 1924, in formal proceedings is shown in the docket list beginning at page 11.

Matters handled informally by the supervisors as a result of their daily supervision of the yards include such things as cleanliness of pens, condition and sufficiency of water supply, promptness in unloading and delivery, price, quality and delivery of feed, promptness in delivery to and removal of livestock from scales, unsatisfactory allotment of turn at scales, incorrect weights, sale of so-called "soft hogs," excessive shrink, unfair distribution of pens, misrepresentation as to terms of sale or quality of livestock, shortage in count of livestock, delayed settlements, loss of animals in stockyards, errors in accounting and docking, humane treatment of livestock to reduce losses to shippers and packers, sale and disposition of reactor cattle and crippled livestock, and revision of tariffs and rules and regulations of market agencies, dealers, and stockyard owners. Much work has been done also with respect to securing competitive conditions, offering livestock on the open market, checking packers' buying methods, and elimination of discriminatory practices.

Matters not coming directly within the scope of the act are also frequently adjusted by the supervisor. By reason of his position in the market and acquaintance with general livestock matters he is often called upon for assistance in connection with some phase of marketing of livestock. Illustrations are: Procuring cars and better transportation facilities for shippers

and producers, improvement in bedding of stock cars, expediting movement of cars by terminal lines to stockyard unloading docks, and similar related operations.

The following specific matters are typical of the problems handled by the supervisors:

(1) Improvements were brought about in facilities for receiving and handling livestock, particularly with respect to deliveries by motor truck, a phase of the livestock industry that is growing more important each year and which presents some unique problems.

(2) Upon complaints of discrimination at certain markets as to prices for hogs delivered by truck as compared with those of similar quality delivered by rail, action was taken which resulted in raising the price level for truck hogs to a par with that paid for rail hogs. As the volume of truck hogs is growing constantly, the benefit to producers is considerable.

(3) Investigation was made of complaints of price discrimination by packers in the purchase of sheep and lambs from certain sections of the Southwest. It was claimed that the differential in price was excessive and not justified by quality or condition. The excuse offered for this discrimination was the presence of burrs in the wool and the penetration of such burrs into the tissues of the carcasses. Investigation showed that this condition existed only in sheep from a comparatively restricted area and packers removed the excessive differential.

(4) An investigation of corn furnished at several markets disclosed that in many cases it was so light in weight that the measured bushel fell short of the standard by several pounds. A better quality of corn was required so that the shipper received the full quantity for which he paid.

(5) Upon complaints at some markets of delays in weighing resulting in loss to shippers by shrinkage, the supervisors, in cooperation with the stockyard companies, succeeded in expediting weighing. In some cases additional scales were installed.

Direct buying by packers and the competitive relation of markets to determine whether there is any manipulation of supply for the purpose of controlling prices have been made subjects of special investigation, which is still in progress.

A special study has been made of the method of handling feed accounts at stockyards. Irregularities were brought to light and corrective measures adopted. Operations of traders at a number of markets were specially observed for the purpose of determining whether they were conducted in accordance with the act. Many traders were found not keeping records and it was necessary to establish a better system of accounting in order that proper audits could be made of their business.

Cooperation has been extended to western cattle associations maintaining brand inspectors at stockyards subject to the act. The inspection of branded cattle by these associations has been held to be a stockyard service within the meaning of the act, and the associations have registered under it and filed a tariff setting up a charge for the services rendered in locating strays and stolen cattle.

## SCALES AND WEIGHING

Through its weight supervisors the administration is endeavoring to bring about conditions that will insure the accuracy of weights obtained for livestock. It is the purpose to see that the scales used are suitable, that they are properly tested and maintained, that they are accurate, and finally that they are properly used. This work is in charge of two livestock weight supervisors. They are working in cooperation with stockyard companies and with city, State, and commercial scale-testing agencies. The livestock market supervisors are being utilized to supervise certain features of the work. The aim has been to organize the work so that the supervisors can check up on the scales and testing methods and locate defects.

The unsatisfactory and improper balancing of scales, which leads to inaccurate weights, has been largely corrected. Weighing rules have been prepared which express in a general and comprehensive manner the proper method of using a scale in weighing and the responsibilities of the weighers. These rules appear to set forth for the first time in a systematic manner an adequate treatment of the subject.

In cooperation with stockyards and manufacturers of scales and others, that type of scales which is most suitable for weighing livestock in small or large drafts under various conditions has been determined and the information furnished to stockyard companies and others interested. The program contemplates the testing of scales at large loads. The administration is aiding the stockyards to work out equipment suitable for this purpose which can be handled readily with a minimum of expense. This contemplates the use of large weights ranging from 1,000 to 4,000 pounds. Test records have been formulated, printed, and furnished for the scale-testing work. Demonstration tests have been conducted at the various stockyards by the weight supervisors, and where such tests were made for the first time some errors and unsatisfactory conditions were found which were unknown to the operators of the scales and furnished valuable information for future operations. As the testing of scales at large capacities introduces a new element in stockyard weighing operations, many difficulties are present which must be overcome.

## BONDS

The general rules and regulations for the enforcement of the packers and



stockyards act, promulgated by the Secretary, were amended effective September 1, 1923, so as to require the execution and maintenance of bonds by market agencies. This regulation was based upon the discretionary authority vested in the Secretary by the act and was justified upon the general business principle that persons handling funds in a fiduciary capacity, as is the case with livestock commission men, should be required to guarantee the safety of such funds. In the act making appropriations for the enforcement of the packers and stockyards act for the fiscal year 1925 the following provision was inserted:

*Provided*, That the Secretary of Agriculture may require reasonable bonds from every market agency and dealer under such rules and regulations as he may prescribe, to secure the performance of their obligations, and whenever, after due notice and hearing the Secretary finds any registrant is insolvent or has violated any provision of said Act, he may issue an order suspending such registrant for a reasonable specified period. Such order of suspension shall take effect within not less than five days, unless suspended or modified or set aside by the Secretary of Agriculture or a court of competent jurisdiction.

Under this authority the previous bonding regulation was amended, effective November 1, 1924, requiring bonds of all market agencies and dealers. The amount of the bond is determined according to the largest amount of livestock purchased or sold on any one day, or the average amount purchased or sold during two business days. The regulation provides for a minimum bond of \$1,000 and a maximum of \$50,000, plus 10 per cent of the excess business, calculated as specified in the regulation. The bonds of the market agencies which had been in effect under the old regulation were adjusted to conform to the new regulation as soon as it was practicable to do so. All market agencies selling livestock on commission have bonds designed to safeguard the payment of proceeds to the shipper, and the work now under way by the administration is to clarify and adjust such bonds so as to cover other obligations reasonably contemplated by the act.

The administration has prepared forms of bonds which it regards as adequate under the regulation. Although a different form of bond may be satisfactory, it has been the policy to procure as nearly as possible a uniform type of bond.

Some legal complications in connection with the interpretation of the law have resulted in considerable delay in compliance by all the packers who buy livestock at public markets. In the enforcement of the bonding regulation the administration has followed the

policy of informal procedure, and as indicated above, this has resulted in satisfactory progress so far as commission firms are concerned. In addition many dealers have furnished bonds. A considerable number of dealers, however, failed to respond, and it appeared that efforts along this line were exhausted. As a result steps have been taken to use the formal procedure prescribed in the act to bring about compliance therewith, and such action against certain traders is now pending.

## COURT DECISIONS INVOLVING TRADE PRACTICES

*Alexander, Conover & Martin Livestock Commission Co. v. United States of America, Equity 568*

In Packers and Stockyards Administration Docket No. 39 the Secretary, on October 13, 1924, directed certain market agencies at Kansas City to cease and desist from discriminating against the Producers Commission Association in refusing it participation in the benefits of the hog-inspection system maintained by the respondents. This order was made without further hearing after the Secretary's order of April 19, 1924, which dealt with the general features of discrimination. The respondents made application for interlocutory injunction restraining the enforcement of this order. On December 23, 1924, the restraining order was issued, the court saying that the order of the Secretary was not within the scope and purpose of the complaint, and, therefore, the respondents had not been accorded due process of law.

*The United States v. Garland Brown and others*

On September 10, 1924, the Bolinger & Spencer Commission Co. and the Producers Commission Association, both registrants under the packers and stockyards act, doing business at the Oklahoma National Stock Yards, Oklahoma City, Okla., filed a complaint with the Department of Agriculture stating in substance that the market agencies and traders doing business at said stockyards had combined and agreed to boycott the Bolinger & Spencer Commission Co. and the Producers Commission Association. An investigation was made by representatives of this department, and as a result thereof a special session of the Federal grand jury was convened, and indictments under section 37 of the criminal code were returned against 55 persons, all registered as market agencies or as



traders and doing business at the Oklahoma National Stock Yards. The indictment specified in substance that the defendants had conspired unjustly to refuse to buy livestock from and sell livestock to the association and the company as above set forth. The alleged offense was based upon the provisions of sections 312 (a) to 315, inclusive, of the packers and stockyards act and the amendment thereto. A demurrer was interposed to this indictment in the district court of the United States for the western district of Oklahoma. By decision of March 2, 1925, Judge Cottrel, district judge, sustained the demurrer upon the following ground:

The unlawful practice set out in the packers and stockyards act is a matter for investigation and decision of the Secretary, and all liability is postponed to await a finding and order by the Secretary of Agriculture. Further, that until he finds adversely the fact can not be said to exist, and in the meantime it is not subject to judicial inquiry and proof. That this is because when the law confides to an executive department the authority to hear and determine matters within its duties, the courts have no jurisdiction until the action of such special tribunal has reached finality.

The court in passing upon the amendatory act of June 15, 1924, stated that:

An obvious difficulty in applying the test of an offense under that act is that there is no allegation in the indictment that there was any notice, hearing, or adverse finding, which condition is necessary before the authority exists to make an order of suspension. The defendants, therefore, can only be regarded as intending to do an act that in contingency would expose them to the supposed penalty. The conclusion seems inevitable that the indictment is deficient in not pleading that the defendants had in contemplation some offending act to which a penalty or liability attaches. The most that can be said is that the indictment charged the defendants were to engage in a practice that would subject them to accusation and hearing, but not to a forfeiture until the Secretary of Agriculture should make an adverse order and they should not obey it. It falls short of charging that the defendants had in contemplation any conduct that arose to the seriousness of an offense and avers only what might after intermediate proceedings ripen into an offense.

On the basis of this decision the Secretary issued an order of inquiry on May 18, 1925, designated as Packers and Stockyards Administration Docket No. 136.

### RATES AND CHARGES

The most usual changes in schedules involve the charges made by stockyard companies for feed. The fluctuation in the market price of feed necessitates these frequent changes. Ordinarily, a stockyard company has two principal sources of revenue—yardage and feed. The yardage charges remain fairly constant, while the feed charges are variable. The spread between the market price of feed and the selling price at the yards often appears to shippers to be rather wide. The fact is frequently overlooked that the income from feed

helps to carry the cost of maintaining the yards. Furthermore, there is considerable expense involved in the distribution of feed in the yards, since it has to be delivered in comparatively small quantities.

The administration endeavors to keep all feed charges in line with and on the basis of the market price plus the customary market differential. The increases in charges are carefully reviewed and checked from this standpoint, and when the market price of feed decreases steps are taken to secure appropriate reductions by the stockyard owners.

There has been a phenomenal growth in the business of delivering livestock by truck at the public stockyards. This has made necessary the installation of special receiving and unloading facilities. In addition, special holding facilities have to be provided, since the usual truck load is much smaller than a car lot. As holding pens have been constructed to receive a carload of livestock, it has become necessary to cut these pens up in many cases so that they will accommodate the smaller lots. A stockyard company gets compensation from the railroad companies for unloading livestock arriving by rail. The practice, therefore, of some stockyard companies in making a higher yardage charge on livestock arriving by truck has seemed to be reasonable. Recently this charge was increased 15 per cent at Wichita, Oklahoma City, and Montgomery. The Montgomery Union Stock Yards Co. made an increase of 15 per cent in its general yardage charges in December, 1925.

There has been very little change in the schedules of market agencies. On several markets the schedules have been revised in order to remove ambiguities. In January, 1925, two cooperative market agencies submitted schedules providing for material reductions in their rates. Upon a thorough investigation into the operations of these organizations it was found that they could safely operate on the lower rates. The lower schedules, therefore, were permitted to become effective. On January 1, 1926, these companies restored the previous rates. The market agency members of the Denver Livestock Exchange filed a new schedule of charges on March 2, 1925, which has resulted as nearly as can be ascertained in a slight increase in some respects. These are the only changes in commission rates during the period covered by this report.

A list of the tariffs of stockyard owners and market agencies at 25 of the markets is appended to this report.

## VALUATION

In connection with the determination of the reasonableness of stockyard charges it is necessary to determine the fair rate of return on the fair value of the property devoted to the service. In order to be informed fully on these questions the administration has three valuation engineers engaged in appraising and working up material on the valuation of stockyard properties.

During the period covered by this report the appraisal of the St. Paul Union Stockyards, which was already under way, was completed. Hearings were held on this valuation, and the case is now under consideration by the examiner for the purpose of making recommendations to the Secretary. An appraisal of the Denver Union Stock Yard was also made. Various matters relating to the value of other stockyard properties were investigated by the engineers, and reports were made to the administration in connection with pending rate questions.

Special investigation and study has been made for the purpose of getting all relevant facts bearing on the reasonable rate of return for stockyard companies. Considerable information has also been secured in regard to the original cost and financing of stockyards throughout the country. Plans are now being made for a continuation of the valuation work at several of the leading markets.

## COURT PROCEEDINGS INVOLVING RATES

By order of June 30, 1924, the Secretary prescribed reasonable rates for stockyard services to be charged by the Peoria Union Stock Yards Co. These charges were as follows:

	Cents per head
Cattle.....	22
Calves.....	11
Hogs.....	7½
Sheep.....	6
Horses.....	22

This represented a 25 per cent reduction on the yardage charges. The order also fixed a definite differential between the market price of feed and the price to be charged by the stockyards company.

The Peoria Union Stock Yards Co. asked the district court of the southern district of Illinois to enjoin the Secretary from enforcing this order. After a hearing on the request for a temporary injunction, the injunction was issued on July 16, 1924, on condition that all the charges prescribed by the Secretary for yardage and feed be complied with, with the exception of

the rate on hogs, which was raised to 9 cents per head. It was further ordered that this order remain in effect only during the pendency of this cause or until the charges mentioned are otherwise fixed as provided by law.

On or about January 23, 1925, the Peoria Union Stock Yards Co. filed a petition with the Secretary asking a reconsideration of the case, it being contended that the value of the property found by the Secretary and the rate of return allowed were not sufficient. It was furthermore contended that there had been a change in conditions at the market which had materially reduced the normal income of the company. The case is still pending in the Federal court on the temporary order.

## AUDITING

A considerable portion of the work of the administration consists in auditing the books and records of persons subject to the act. In the doing of this work the administration endeavors to be helpful and to use the information obtained for constructive purposes. Competent auditors have been constantly engaged in auditing the books of market agencies and dealers. As a result of this work action was taken with respect to concerns that did not appear to be financially strong for the purpose of protecting and safeguarding the rights of persons whom they represent or with whom they deal. During the last fiscal year considerable work has been done with respect to a number of concerns of the type just referred to. It will be appreciated that the knowledge on the part of a market agency or dealer that his books and records will be examined from time to time has a most salutary effect. Financial and statistical reports were received during the fiscal year from 58 stockyard companies, from 525 packing establishments, and from 684 market agencies, located at 52 different stockyards. From the various reports comprehensive tabulations have been made covering the operations of each agency.

## SUMMARY OF REPORTS BY THE DIVISION OF AUDITS AND ACCOUNTS

During the period July 1, 1924, to February 28, 1926, the following audits and investigations were made:

General reports.....	62
Audits of hog and sheep traders.....	103
Audits of cattle traders.....	36
Audits of order buyers.....	15
Trade practice audits.....	74
Financial audits.....	387
Stockyards audits.....	37

Total audits and investigations..... 714



The general reports consisted of investigations pertaining to general marketing conditions, such as weighing-up, trading activities, feed account, and statistical tabulation.

The reports on cattle, hog, and sheep traders show, in most cases, the number of head, weight, dockage, and value of animals purchased and sold, together with the expenses incurred by the trader and the net profit realized. These reports pertain chiefly to traders operating on the five largest terminal markets.

The trade practice investigations disclosed a number of alleged violations of the packers and stockyards act or violations of the rules and by-laws of the livestock exchange involving market agencies. These audits were referred to the division of trade practices for review and disposed of by formal action, as shown in the report of dockets, or by informal action, as indicated elsewhere in this report.

The majority of financial audits set forth the result of operations of market agencies for the year 1925. Ninety of the 387 firms were found to be in weak financial condition, and these firms were closely watched by the auditors and supervisors in order to prevent loss to shippers.

Twenty-three of the audits of stockyard companies were complete audits covering a period beginning as far back as records could be found available, either of the present operating company or its predecessors. They include a financial history of the original organization, financing, and securities which have been issued up to the present time. Schedules of land, buildings, and equipment have been prepared for the information of the engineering division should a valuation of the stockyards property be undertaken in connection with the regulation of rates.

Investigations of the books of a number of small packers were made for the purpose of obtaining information relative to the present form of accounts and the general business conducted by such packing concerns.

### SPECIAL PROBLEMS

Special problems of general interest to the livestock industry have presented themselves from time to time. While they are fundamentally economic in character, they do require study and analysis from a regulatory standpoint. Recently the administration has devoted considerable effort to these questions in cooperation with the Bureau of Agricultural Economics. Foremost among these problems are:

The practice of direct buying by packers, the competitive relation of markets, and the factors influencing the fluctuations in the prices of livestock and meat.

The question of direct buying by packers presents itself in several different ways. In the first place some packers buy livestock directly from the shippers in the country. In other cases they buy livestock through concentration points. Livestock purchased in either one of these ways may be shipped to a packer who is not located at a public market. On the other hand, it may be shipped to a packer located at the public market and in that case may pass through the yards or may go directly to the private yard of the packer. In any case the livestock does not pass through the regular selling machinery of the public market. There is a variation of opinion in regard to the effect of this practice on the public market. It has been contended by some that this practice is the means used by the packer to manipulate the price. It has been the purpose of the administration to get all possible information in regard to this question so that the influence of direct buying by packers could be properly appraised.

The competitive relation on the livestock markets has arisen in several cases involving regulatory activities of the administration. In connection with the fixing of rates of stockyards services, there has been considerable discussion as to what weight should be given to the variation in charges for services between different markets. A study and investigation of this general question is being made for the purpose of determining how much consideration should be given to this factor in rate regulation. There is also another feature to this question of competition between markets. It has been contended that the packers have intentionally withdrawn their support from those yards in which they are no longer financially interested, and that livestock is being diverted to the plants of packers at those yards in which they are financially interested. The merits of such a contention are being carefully investigated.

In the late spring and early summer of 1925 there was a very wide fluctuation in the price of hogs on some of the central markets. Later in the year there was considerable complaint in regard to the spread between the price of cattle and the selling price of meat. In both cases it was alleged by some that such facts were an indication of manipulation. The administration is



endeavoring to work out a systematic program of investigation of these questions for the purpose of determining what factors account for these particular situations.

### OPINIONS BY THE ATTORNEY GENERAL

The Attorney General rendered four opinions at the request of the department relative to the enforcement of the packers and stockyards act.

#### HOG INSPECTION AND DOCKAGE

A question had been raised on numerous occasions regarding the status of the hog inspection and dockage service. The Attorney General on August 14, 1924, ruled that these services as rendered by the Chicago Livestock Exchange at the Chicago market constitute a stockyard service within the meaning of the packers and stockyards act, and that the exchange should register and be governed accordingly.

#### WEIGHING LIVESTOCK

In view of the apparent conflict between the laws of the State of Minnesota and the packers and stockyards act involving livestock weighing service at the St. Paul market, the Attorney General was asked to give his opinion in the matter. In his opinion of December 22, 1924, he discusses the whole situation fully and concludes by ruling that under the packers and stockyards act a stockyard company must furnish this stockyard service, and that the Secretary of Agriculture is charged with the responsibility of seeing that such services are rendered in accordance with the requirements of the act. The weighing service at the St. Paul market under the State law has been performed by the State through the Minnesota Railroad and Warehouse Commission, and the service is maintained by assessing fees on a per head basis. The entire matter has been referred to the Department of Justice for appropriate action in accordance with the opinion.

#### PATRONAGE DIVIDENDS

The question was presented to the Attorney General whether under the packers and stockyards act a cooperative association of producers, operating a market agency, can lawfully pay a dividend out of surplus earnings to a shipper patron who was not a member of the association at the time he shipped his livestock to such market agency and such livestock was sold by it, but who prior to distribution of the dividend became a member of such association. The Attorney General, on September 18, 1924, held that the provisions of the act relating to rates and charges and prohibition of rebates must be construed to speak as of the time when a market agency performs the service for its patrons, which is at the time the sale of livestock takes place. The rates and charges then in force and effect for such services must be charged. The right of the producer to participate in the patronage dividends vests at the time he becomes a member of the cooperative market agency, and then only with reference to the earnings on subsequent transactions.

#### ADMISSION OF EVIDENCE IN COMMISSION RATE CASES

In connection with the inquiry into the reasonableness of commission rates at the National Stockyards, objection was made by the counsel for the respondents to the introduction of information bearing on the operations of each firm. The Government auditors had obtained certain information regarding the organization of the firms, the volume of business, and the status of their financial operations. It was the view of the administration that such information was essential to a full and proper inquiry into rates. The examiner admitted the exhibits in the record subject to a ruling by the Attorney General. In his opinion of July 29, 1925, the Attorney General held that such exhibits were properly admitted as they embody information material to the issue and were necessary in carrying out the provisions of the act.

### INDEX TO FORMAL DOCKETS

PENDING JULY 1, 1924

Docket No.	Subject	City	Status
6	Stockyard rates .....	Omaha.....	Pending.
7	do .....	Chicago.....	Do.
9	Commission rates .....	Portland.....	Do.
10	do .....	Fort Worth.....	Dismissed.

## PENDING JULY 1, 1924—Continued

Docket No.	Subject	City	Status
15	Commission rates	Denver	Dismissed.
19	Trade practice	(Armour-Morris merger)	Do.
24	Stockyard rates	Pittsburgh	Pending.
25	do.	Detroit	Dismissed.
26	do.	Buffalo	Do.
39	Trade practice	Kansas City	Cease and desist order.
57	do.	St. Paul	Dismissed.
76	do.	Omaha	Cease and desist order.
78	do.	Indianapolis	Do.
80	do.	Richmond	Do.
81	do.	St. Paul	Dismissed.
82	Stockyard rates	Spokane	Do.
83	Commission rates	Oklahoma City	Pending.
85	Trade practice	Chicago	Dismissed.
87	Stockyard rates	Nashville	Do.
88	Trade practice	St. Joseph	Cease and desist order.
89	do.	Buffalo	Do.
90	do.	do.	Do.
91	do.	do.	Do.
92	do.	St. Joseph	Dismissed.
93	do.	Philadelphia	Do.
95	do.	Omaha	Cease and desist order.
96	do.	Sioux City	Do.
97	do.	Chicago	Reparation awarded.
98	do.	Omaha	Cease and desist order.
99	do.	Buffalo	Do.
100	do.	do.	Do.
101	do.	St. Paul	Dismissed.
103	do.	Philadelphia	Cease and desist order.
104	do.	St. Joseph	Do.
105	do.	Philadelphia	Dismissed.
106	do.	Fort Worth	Do.
107	do.	Jacksonville	Cease and desist order.
109	do.	Salt Lake City	Dismissed.
110	do.	Chicago	Do.
111	do.	Ogden	Do.
112	do.	Salt Lake City	Do.
113	do.	Omaha	Cease and desist order.
114	do.	St. Joseph	Dismissed.
115	do.	Denver	Cease and desist order.

## INSTITUTED JULY 1, 1924, TO MARCH 24, 1926

116	Stockyard rates	St. Paul	Pending.
117	Trade practice	New York City	Cease and desist order.
118	do.	Cincinnati	Do.
119	do.	do.	Do.
120	do.	do.	Do.
121	do.	do.	Do.
122	Commission rates	National Stockyards	Consolidated with 132.
123	do.	do.	Do.
124	do.	do.	Do.
125	Trade practice	Baltimore	Cease and desist order.
126	do.	do.	Dismissed.
127	do.	do.	Do.
128	do.	Sioux City	Do.
129	do.	Baltimore	Do.
130	do.	Philadelphia	Cease and desist order.
131	Stockyard rates	Newark	Dismissed.
132	Commission rates	National Stockyards	Pending.
133	Trade practice	Chicago	Dismissed.
134	do.	Denver	Cease and desist order.
135	do.	National Stockyards	Do.
136	do.	Oklahoma City	Pending.
137	do.	Kansas City	Dismissed.
138	do.	Chicago	Suspension.
139	do.	do.	Do.
140	do.	do.	Cease and desist order.
141	do.	Kansas City	Pending.
142	do.	Chicago	Suspension.
143	Commission rate	Omaha	Pending.
144	Trade practice	National Stockyards	Suspension.
145	do.	Milwaukee	Pending.
146	do.	Cleveland	Suspension.
147	Commission rate	Sioux City	Pending.
148	Trade practice	Chicago	Do.
149	do.	do.	Do.
150	do.	do.	Do.
151	Commission rates	Sioux City	Do.

## SUMMARY STATEMENT OF ACTION IN FORMAL DOCKETS

Pending July 1, 1924:		Dismissed:	
Rate cases	11	Rate cases	7
Trade practice cases	33	Trade practice cases	20
	44		27
Instituted:		Cease and desist orders:	
Rate cases	9	Trade practice cases	28
Trade practice cases	27		28
	36	Suspensions:	
Total	80	Trade practice cases	5
			5
Pending Mar. 24, 1926:		Reparation:	
Rate cases	10	Trade practice cases	1
Trade practice cases	6		1
Consolidated rate cases (see Docket 132)	3	Total	80
	19		

## FORMAL PROCEEDINGS

There appears in the list of formal dockets in this report a brief statement with respect to the salient features of each docket concerning the issues involved and the action taken. For the purpose of showing in a more specific manner the extent of certain investigations and the scope of testimony taken and information secured, a brief descriptive statement follows in connection with a few of the more important cases that have received attention under the packers and stockyards act.

The so-called Armour-Morris merger case is designated as Docket No. 19. Hearings were held in this case extending over more than 80 days. The hearings began on April 30, 1923, and were held at Kansas City, Mo., East St. Louis, Ill., Omaha, Nebr., Chicago, Ill., Denver, Colo., New York City, and Washington, D. C., from time to time until they were terminated on October 31, 1924. There were 322 witnesses who testified, including 73 called by the Government and 249 by the respondents. The record, exclusive of pleadings and a number of exhibits offered by reference only or not copied in the record, consists of 12,265 pages. There were several hundred exhibits, consisting of books, documents, statistical tables, charts and diagrams. The Government had three attorneys engaged almost continuously in connection with this hearing, as well as a large number of accountants and clerical assistants.

Docket No. 116, involving the rates and charges of the St. Paul Union Stockyards, was initiated on July 11, 1924. Hearings in this case were held at St. Paul, Chicago, and Washington, D. C., and in all a total of approximately 50 days were consumed in taking testimony. Previous to the hearings a staff of three valuation engineers and several assistants were employed in appraisal of the property, this work

requiring approximately 45 days. Eighteen witnesses testified for the Government and 28 for the respondent. A total of approximately 4,000 pages of testimony was taken, together with the introduction of 130 exhibits for the Government and 145 for the respondent.

Docket No. 136 involves charges of unfair and unjust discrimination in the buying and selling of livestock at the Oklahoma City Stockyards. Hearings in this docket commenced on June 29, 1925, and terminated on August 13, making a total of approximately seven weeks consumed in the taking of testimony. There are approximately 4,000 pages of transcript in this case, and the exhibits introduced total 76 for the Government and 82 for the respondents. There were 123 witnesses who testified, including 53 called by the Government and 70 by the respondents. The testimony in this case covered practically every phase of the marketing of livestock as carried on at the ordinary public stockyards market.

## FORMAL DOCKETS

In addition to the cases which have been initiated since June 30, 1925, this report includes also all cases that were pending at that time, showing what action, if any, has been taken.

*Docket No. 6.*—Union Stockyards Co. of Omaha (Ltd.), South Omaha, Nebr.

This is a case involving a charge for livestock "planted and resold" in the commission division of the Union Stockyards Co., of Omaha, located at South Omaha, Nebr. The charge so assessed was equal to one-half of the yardage charge for yarding livestock and is commonly known as a "reweigh charge." Complaint was made to the Secretary that this charge was unjust, unreasonable and discriminatory under Title III of the packers and stockyards act. Upon the basis of this complaint and upon his own motion, the Secretary on June 8, 1922, ordered that a general inquiry be made into the yardage, feed, weighing, and other charges of the



stockyards company, in order to determine a just and reasonable basis for establishing a tariff. A hearing, ordered by the Secretary, was begun on September 18, 1922. The examiner's findings on the basis of the record were issued on March 5, 1923. Upon the basis of the record, the Secretary found the reweigh charge to be discriminatory. The company thereupon filed a tariff purporting to remove the discrimination. This tariff was later suspended also. The Omaha Stockyards Co., stipulated with the Secretary of Agriculture for an indefinite suspension of its tariff until the Chicago case could be decided. (See docket 7 following.)

As a result of the order of the Secretary declaring the original reweigh charge discriminatory, claim for reparation was filed by complainant T. G. Inghram, a registered dealer. On January 6, 1925, a hearing was held, and the claim for reparation was dismissed on May 13, 1925.

A general inquiry into all rates is pending.

*Docket No. 7.*—Union Stockyards and Transit Co., Chicago, Ill.

This is a case involving the question of whether a reweigh charge is unreasonable and discriminatory against dealers in the Union Stockyards, Chicago. The case arose out of a complaint on the part of dealers engaged in buying and selling livestock on this yard.

Acting upon this complaint and upon his own motion, the Secretary of Agriculture on June 8, 1922, ordered that a hearing be held for the purpose of determining the question of whether a reweigh charge is unjust and discriminatory and on the reasonableness of all rates and charges for stockyard services.

The stockyards company then filed a tariff purporting to remove the discrimination. This tariff was suspended and a further hearing ordered. In accordance with this order of the Secretary, a hearing was held beginning October 9, 1922. On June 22, 1923, a report, findings and conclusion relative to the reweigh charge was made by the examiner, and the Secretary ordered a discontinuance of this charge. Upon the basis of the record, the examiner recommended a decrease in the charges for stockyard services and suggested a differential between the price of corn and the charges made for it to livestock shippers.

The case was argued before the Secretary on October 2, 1924, at Washington, D. C., and the parties were given three weeks in which to file written argument. The case is now pending.

*Docket No. 9.*—American National Livestock Association et al. v. The Market Agencies Operating at North Portland, Ore.

This is a case of the American National Livestock Association and others against those market agencies operating at the Portland Union Stockyards, North Portland, Ore. The complainant filed with the Secretary on July 25, 1922, a petition averring that commission charges for the sale and purchase of livestock were unjust, unreasonable, and discriminatory. The complaint contains also a request for reparation and a prayer for future relief from the charges declared to be unjust, unreasonable, and discriminatory. An answer was filed by the respondents on September 15, 1923, in which a general denial of all allegations of the complaint, except those relating to jurisdiction, was made. It seemed to the Secretary that there were reasonable grounds for investigating this complaint and he, therefore, issued an order on May 29, 1924, that a proceeding be had under Title III of the packers and stockyards act for the purpose of allowing the parties to be heard.

A hearing was begun on July 22, 1924, before an examiner for the Packers and Stockyards Administration. On the basis of this record, the examiner made a report of findings of fact and recommendation to the Secretary on November 10, 1924. The examiner found upon the basis of the record that the rates and charges being made at the time of the complaint were unreasonable and set forth a schedule of rates which, in his judgment, would be reasonable. The respondent filed exceptions to the report of the examiner on December 15, 1924, and an oral argument before the Secretary was requested. The case is pending.

*Docket No. 10.*—American National Livestock Association v. Market Agencies Operating at Fort Worth, Tex.

This case involves a complaint filed on July 25, 1922, by the American National Livestock Association, the National Woolgrowers' Association, and others against the market agencies operating at the Fort Worth Stockyards. The complaint alleged that the rates and charges for the sale and purchase of livestock on a commission basis were unjust, unreasonable, and discriminatory and unlawful under the packers and stockyards act. The petition further alleged that the commission charges were discriminatory, unjust, and unreasonable because the selling price of the livestock was not a factor in determining the commission

charges. The respondents filed an answer to this complaint on September 30, 1922. The Secretary determined that there were reasonable grounds for investigating the situation and ordered that a hearing be held beginning March 19, 1923. A hearing lasting from April 11 to 14, 1924, was subsequently held. Based upon the evidence, the examiner on November 14, 1924, made his report, findings of fact, and recommendations to the Secretary, in which a schedule of commission charges was recommended as reasonable. This case was dismissed without prejudice by the Secretary on March 3, 1925.

*Docket No. 15.*—American Commission Co., et al. v. Denver Union Stockyards, Denver, Colo.

This case was initiated by the Secretary on October 30, 1922. It involves the reasonableness of commission rates charged by market agencies engaged in buying and selling livestock at the Denver Union Stockyards. It grew out of the fact that on October 14, 1922, the respondent filed with the secretary and published a new joint tariff raising rates to become effective November 1, 1922.

Hearings were held before an examiner for the Packers and Stockyards Administration. On the basis of the information elicited at these hearings the examiner issued on November 10, 1924, his report, findings, conclusions, and recommendations. He found that the proposed increased commission charges as set forth in the tariff were unreasonable and recommended a schedule of charges which, in his opinion, was reasonable. This case was dismissed without prejudice by the secretary on March 3, 1925.

*Docket No. 19.*—Secretary of Agriculture v. Armour & Co., et al.

This case arose out of the proposed merger of Armour & Co., and Morris & Co. Hearings were opened at Kansas City, Mo., on April 30, 1923. Subsequent to this date numerous hearings were held at different places throughout the country. The voluminous record in this case comprises 12,265 pages, and several hundred exhibits consisting of books, documents, statistical tables, charts, and diagrams. A history and disposition of it are given in the conclusion and order of the Secretary under date of September 14, 1925, which follows:

# UNITED STATES OF AMERICA BEFORE THE SECRETARY OF AGRICULTURE, PACKERS AND STOCKYARDS ADMINISTRATION

Secretary of Agriculture, complainant, v. Armour & Co. of Illinois, Armour & Co. of Delaware, North American Provision Co., J. Ogden Armour, and Morris & Co., respondents. Docket No. 19.

## CONCLUSION AND ORDER

This proceeding had its inception in several conferences in November and December, 1922, between the then Secretary of Agriculture, Hon. Henry C. Wallace, and officials of Armour & Co., in which the Secretary was informed that there was under consideration a purchase by Armour & Co. of the physical properties, business, and good will of Morris & Co. These officials expressed to the Secretary the hope that the proposed purchase would not be found to be in violation of law and that it would not meet with the opposition of the Department of Agriculture. On November 22, 1922, the Secretary addressed an inquiry to the Attorney General as to whether the terms of the packers and stockyards act contemplated or required him to take any action with regard to such transaction in advance of its consummation. To this the Attorney General replied that the act did not require the Secretary to take any formal action unless he had reason to believe that the law had been violated or was being violated, and that to constitute a violation of the act there must be something more than a mere statement of what a person or corporation contemplates. Concluding his opinion, the Attorney General added that the act vested the Secretary with broad powers of inquiry, and that he might make such inquiry.

On December 22, 1922, in response to Senate Resolution 364 of December 6, 1922, Secretary Wallace informed the Senate of the conferences he had had with the officials of Armour & Co., of his request to the Attorney General for opinion above referred to, and the opinion. In this report he stated that he had given careful consideration to the packers and stockyards act, particularly to that portion which makes it unlawful for any packer "to engage in any course of business or do any act for the purpose or with the effect of manipulating or controlling prices in commerce, or of creating a monopoly in the acquisition of, buying, selling, or dealing in any article in commerce, or of restraining commerce." He then stated that there was nothing in the act itself which specifically prohibited the purchase by one packer of the physical assets of another and that the question seemed to be whether out of such a transaction would flow conditions or conduct which would come within the prohibitions of the act. He then referred to a conference between the President, the Attorney General, and himself on November 27, at which there was unanimity of agreement that there was no obligation upon either of them to indorse or acquiesce in the action proposed or to express an opinion concerning it; that, on the contrary, each was firmly of the opinion that none of them would or could be expected to approve in advance a transaction of this kind; and that the real question under discussion was whether the proposed purchase and sale might, in and of itself, be a violation of the law, or whether it was of such a nature as to warrant action by any of them in advance of its consummation. He concluded his report to the Senate with the following paragraph:

"For some weeks I have been making certain investigations and studies for the purpose of trying to measure the probable effect upon competition in the buying of livestock and the selling of meat if the suggested purchase and sale should be completed, but as yet no occasion seems to have arisen which requires formal action. As to future action, that will depend altogether upon future events."



On December 30, 1922, J. Ogden Armour, acting for himself and in behalf of Armour & Co. of Illinois, entered into a written contract with Morris & Co., to acquire all the physical assets, business, and good will of Morris & Co.

Thereafter, on February 17, 1923, the Secretary, having learned of the execution of this contract, issued and caused to be served upon Armour & Co., of Illinois, Armour & Co., of Delaware, J. Ogden Armour, and Morris & Co., as respondents, a complaint charging, in paragraphs 9, 10, and 11, as follows:

"That the acquisition of said assets and business of Morris & Co., by the respondents, J. Ogden Armour and Armour & Co., of Illinois or Armour & Co., of Delaware, on the one hand, and the acquisition of the stock of Armour & Co., of Illinois, or of Delaware by Morris & Co., on the other hand, as provided for in said contract or contracts, has the tendency or effect of restraining interstate commerce or of creating a monopoly in many sections and communities in various States of the United States in the purchase of livestock and in the shipment and sale of meat and other livestock products in many sections and communities in various States of the United States and in foreign countries.

"That in the making of said contract or contracts or the carrying out thereof, the respondents, J. Ogden Armour and Armour & Co., of Illinois, or Armour & Co., of Delaware, are engaged in a course of business and have done an act for the purpose or with the effect of manipulating or controlling prices in the buying of livestock and the sale and distribution of the products thereof in interstate and foreign commerce and for the purpose or with the effect of restraining interstate and foreign commerce or of creating or tending to create a monopoly therein.

"That by the acquisition by Armour & Co., of Illinois or Armour & Co., of Delaware of the assets and business of Morris & Co., including the stock or share capital or business of other corporations owned in whole or in part by Morris & Co., the names of which corporations are contained in said contract or contracts and the schedule or schedules annexed thereto, and the acquisition by Morris & Co., as set forth in this complaint of the stock or share capital of Armour & Co., of Illinois or Delaware, the respondents have combined, arranged and agreed to eliminate entirely the respondent Morris & Co., as a competitor of the other respondents and to materially increase the power of the other respondents to control and dominate the livestock and meat-packing industry in the United States and foreign countries, thereby restraining interstate commerce in many sections and communities in the United States and foreign countries in the purchase of livestock and the sale of livestock products, or tending to create a monopoly in interstate and foreign commerce in the buying of livestock and the sale and distribution of the products thereof in the United States and foreign countries."

On March 24, 1923, J. Ogden Armour and the North American Provision Co., entered into a supplemental written agreement with Morris & Co., and all of its stockholders for the sale of the physical properties, business and good will of Morris & Co., and its subsidiaries to the North American Provision Co., a subsidiary of Armour & Co. This agreement modified the original agreement of December 30, 1922, by providing among other things that no stock or share capital owned in whole or in part by Morris & Co., should be transferred to Armour & Co., or its nominee, the North American Provision Co. By virtue of this provision in the supplemental agreement, the charge contained in paragraph 11 of the complaint is eliminated from consideration. The purchase was consummated on March 28, 1923, since which time Morris & Co., has not engaged in the meat-packing business.

On April 23, 1923, the respondents filed an answer in which they specifically denied that they had violated or were violating any of the provisions of the packers and stockyards act, and further setting up as an affirmative defense that the purchase was made in good faith and as an economic and industrial necessity.

Upon the issues thus joined, hearings were commenced at Kansas City, Mo., on April 30, 1923, on which date the North American Provision Co.,

was made a party respondent to the proceedings by and with its consent and that of the other respondents. These hearings proceeded from time to time and were finally concluded at Chicago on October 31, 1924. The record thus made consists of 12,265 typewritten pages and several hundred exhibits.

At the close of the hearings on October 31, 1924, time was allowed until January 2, 1925, for counsel for the Government, and until February 21, 1925, for counsel for the respondents, to draft and submit for consideration of the Secretary proposed findings as to the facts. Such findings were prepared and submitted within the time allowed. Oral argument was had before me beginning on April 6, 1925, and concluding on April 11.

The provisions of the packers and stockyards act which I conceive to be pertinent to this case are Title II, section 202, subdivision (e), which reads as follows:

"It shall be unlawful for any packer to engage in any course of business or to do any act for the purpose or with the effect of manipulating or controlling prices in commerce, or of creating a monopoly in the acquisition of, buying, selling, or dealing in, any article in commerce, or of restraining commerce."

Decision as to the legality of the acquisition by Armour & Co., of the physical properties, business and good will of Morris & Co., involves, at the outset, consideration of the question whether such acquisition, in and of itself, constitutes a violation of the above cited provision of the act. The purchase by one competitor of the physical properties, business and good will of another competitor is not in express terms condemned by this statute. Since Congress is presumed to legislate with full knowledge of the subject-matter, it must be assumed, without adverting to the numerous hearings which had brought that knowledge specifically to them, that it knew of the existence of the so-called big five packers and of such influence as they exercised, or were in a position to exercise, in the livestock and meat packing industry, and that it knew of the results which might flow from any acquisition by one packer, or one large packer, of the physical properties, business and good-will of another. With this background, it would have been very easy for Congress, when legislating to prevent evils in the packing industry, to have incorporated in its legislation a prohibition of the acquisition of the properties, business and good will of one packer by another. The fact that it did not do so argues that it did not intend to do so, but left open a field for the lawful and normal disposition of their properties by competitors subject to this act. This conclusion is strengthened by the fact that in the Clayton Act the acquisition of the whole or any part of the stock or other share capital of a competitor, with the effect of substantially lessening competition, is forbidden in express terms. Manifestly, therefore, the purchase by Armour & Co., of the physical properties, business and good will of Morris & Co., is not forbidden by the act unless it be made for the purpose or with the effect of manipulating or controlling prices in the buying of livestock in commerce or in the sale and distribution of livestock products, or of creating a monopoly in the acquisition of, buying, selling, or dealing in such articles in commerce, or of restraining commerce.

The purchase by Armour & Co. of the physical properties, business, and good will of Morris & Co. creates no legal presumption of a purpose to accomplish the ends forbidden by the act.

There is not in this record sufficient evidence upon which to base a conclusion that the acquisition of the physical properties, business, and good will of Morris & Co. by Armour & Co. was for the purpose of manipulating or controlling prices in the buying of livestock in commerce or in the sale or distribution of their products, or of creating a monopoly in the acquisition of, buying, selling, or dealing in such articles in commerce, or of restraining commerce. On the contrary, the evidence is persuasive that it was for the purpose of effecting economies in the conduct of Armour respondents' business by reducing overhead expenses and increasing the volume of sales of the finished products.

There remains, therefore, for consideration, whether this acquisition by Armour & Co. has had



the effect of manipulating or controlling prices in commerce, or of creating a monopoly, in the acquisition of, buying, selling, or dealing in any articles in commerce, or of restraining commerce.

The evidence in the record does not warrant the conclusion that the purchase by Armour & Co. of the physical properties, business, and good will of Morris & Co. has had the effect of unduly or arbitrarily lowering prices to the shipper who sells livestock, or unduly and arbitrarily increasing the price of livestock products to the consumer who buys, or otherwise manipulating or controlling prices in commerce.

The evidence discloses that since the acquisition of Morris & Co. by Armour & Co., the latter has controlled less than 25 per cent of the Federal-inspected slaughter and less than that controlled by Swift & Co. The undisputed evidence shows that competition on the whole in the sale of meats and meat food products in interstate commerce has not been diminished. Consequently, the acquisition has not had the effect of creating a monopoly.

The question still remains whether this acquisition has had the effect of restraining commerce. It is obvious that the elimination from business of one competitor resulting from the acquisition of his business by another competitor extinguishes competition between the two and may tend to lessen competition in that field of business, but since the decisions of the Supreme Court of the United States in the Standard Oil and Steel cases (Standard Oil Co. v. United States, 221 U. S. 1; United States v. United States Steel Corporation, 251 U. S. 417), it has been settled law that the mere lessening of competition through the acquisition of one competitor by another does not amount to an unlawful restraint of trade or commerce. While Morris & Co., has been eliminated as a competitor it does not necessarily follow that competition as a whole has been thereby reduced. It may be said with very good reason that the merger has resulted in making of Armour & Co., a more potential competitor of the largest existing packer, Swift & Co.

As was said in the Steel case, "the law does not make mere size an offense or the existence of unexerted power an offense," but in order that such a combination may be declared unlawful, it must be shown to have restrained trade or commerce unreasonably or unduly, or that the power thereby acquired is being used for the accomplishment of the evil which the law was aimed to prevent. In the Steel case, the control secured by the various acquisitions was about 45 per cent. In the Quaker Oats case (232 Fed. 499) the control secured by the acquisitions was approximately 60 per cent, yet the court held that this did not constitute a violation of the antitrust laws. In its opinion in this case, the court said:

"Every purchase between two people in the same business, one buying out the other, is necessarily a lessening of competition, but as long as the property is such that the fullest opportunity for country wide competition exists, the field being open to everybody with but small capital, there being no patent rights, there being no other hindrance to the development of individual enterprise, I fail to see anything undue, anything unreasonable, in the restriction of competition that results, although it be the largest of the several competing firms that buys out the second largest."

This language has peculiar application to the case before me.

Much evidence was introduced both by the Government and the respondents as to the effect of competition before and since the acquisition. The overwhelming weight of the testimony is in favor of the view that competition has not been materially lessened by reason thereof, either in the buying of livestock or the sale of the meat or meat products thereof. Scores of independent packers were called by the respondents and they all testified that in the handling and sale of meat and meat food products competition has been keen and active. Many large retail dealers scattered throughout the country were placed on the stand by the respondents and they testified that competition was keen and active and that no unfair practices or coercive methods had been engaged in by Armour & Co. The evidence further discloses that during the last decade both the number of independent packers of substantial

size and the volume of business done by them have largely increased.

My understanding is that the cases involving the merger of competing railroad systems or the acquisition by corporations of the stock or share capital of competitors in violation of the express prohibition of section 7 of the Clayton Act are not applicable to this case. It undoubtedly is true that the Supreme Court has distinguished between combinations of public utilities and combinations of industrials, holding combinations of the former class to be unlawful without regard to the purposes of their formation or their effect on competitive conditions generally. While the packers and stockyards act apparently classes stockyards as public utilities, it has not impressed the packing business with a public use, and combinations of packers are to be treated as industrial combinations.

In the argument before me it was suggested that the lack of change in competitive conditions since the acquisition was more apparent than real, due, perhaps, to the pendency of this proceeding, and that the real effect of the acquisition on competition would appear after the disposition of this case. Without attempting to forecast the future policy of Armour & Co. in the conduct of its business, it is a sufficient answer to this suggestion to say that in the event that Armour & Co. violates any of the provisions of the packers and stockyards act there is ample power and authority in the Secretary of Agriculture under that act to take appropriate and effective action.

After careful consideration of the entire record and the arguments of counsel, I find and conclude that the evidence is insufficient to sustain the charges made in the complaint, and therefore this proceeding is dismissed without prejudice, and it is so ordered.

September 14, 1925.

W. M. JARDINE,  
Secretary of Agriculture.

*Docket No. 24.*—Pittsburgh Union Stockyards Co., Pittsburgh, Pa.

This is an inquiry into the rates and charges at the Pittsburgh Union Stockyards initiated by the Secretary by reason of a tariff filed on April 11, 1923, and to become effective April 22, 1923, increasing the price charged for corn. In addition to the inquiry into the reasonableness of the increased charges for corn, a general inquiry was ordered by the Secretary on May 31, 1923, into the reasonableness of all rates and charges at this yard. A hearing was held on June 18, 1923, and continued on March 25, 1924. The examiner issued his report and findings on October 14, 1924. The respondent filed exceptions to these findings on December 27, 1924, and requested an oral argument before the Secretary. Later a request was made by the respondent that another hearing be granted. The attorney for the Government also filed exceptions. The examiner is now arranging for an appropriate date for the taking of further testimony. This case is pending.

*Docket No. 25.*—Michigan Central Railroad Co., Detroit, Mich.

This case arose out of the fact that the Michigan Central Railroad Co., which operates the Detroit stockyards, filed on May 16, 1923, a schedule increasing the charges for the yarding

of livestock. A hearing was held on September 10, 1923, and adjourned without date. On the basis of the record the examiner issued his proposed findings of fact on December 31, 1923. On the basis of these facts, it was his opinion that the proposed increases in the rates and charges for yarding livestock were not justified. Exceptions to the findings of the examiner were filed on March 7, 1924. The case was argued before the secretary in Des Moines, Iowa, on July 21, 1924. In order that additional evidence might be introduced, and at the request of the respondent, hearings were held on June 5, 1925, and continued on June 26, 1925. At these hearings additional testimony was introduced by the respondents in respect to the value of the property. Upon consideration of the whole record, it appeared that no basis existed upon which to reach a conclusion that the rate of return was unreasonable. The case was dismissed without prejudice by the Secretary on January 30, 1926.

*Docket No. 26.*—New York Central Railroad Co., Buffalo, N. Y.

On June 4, 1923, the New York Central Railroad Co., which operates the Buffalo stockyards, filed with the Secretary a tariff increasing the charges for yarding livestock at the Buffalo stockyards. The Acting Secretary on June 26, 1923, ordered a hearing on the reasonableness and lawfulness of the increased rates and charges as provided in the new tariff. Pursuant to this order, hearings were held on September 13, 1923. On the basis of the record made at this hearing, the examiner on January 2, 1924, issued his tentative findings of facts and recommendations. On the basis of these facts, it was the opinion of the examiner that the increases in rates for yarding livestock were not justified. The respondent requested that the case be reopened, and on April 10, 1924, a hearing was held, at which testimony was introduced as to value. Upon further request of the respondent that additional evidence be introduced into the record on the question of going value and rate of return, subsequent hearings were held on June 5, 1925, and June 26, 1925. Additional testimony was introduced by the respondents in respect to these matters. Upon consideration of the whole record it appeared that no basis existed upon which to reach a conclusion that the rate of return was unreasonable. The case was dismissed without prejudice by the Secretary on January 30, 1926.

*Docket No. 39.*—Alexander, Conover & Martin Bros. et al., Kansas City, Mo.

This case involved certain alleged acts of discrimination by market agencies at the Kansas City market against the Producers Commission Association. The original order issued, by the Secretary on April 19, 1924, covered all matters with the exception of hog inspection and dockage. This subject was reserved for further action, and in pursuance thereof on October 13, 1924, he directed the market agencies to cease and desist from discriminating against the Producers Commission Association by failing or refusing to extend to said Producers Commission Association participation in and the benefits of said hog-inspection system, or to permit its use thereof, upon payment of reasonable and customary charges therefor. Subsequently, the market agencies sought an injunction against said order, which injunction was granted on the ground that the original complaint did not put respondents on notice that hog inspection was an issue in the case.

*Docket No. 57.*—Central Cooperative Commission Association, Union Stockyards, South St. Paul, Minn.

On January 7, 1924, the Secretary of Agriculture instituted an inquiry into the activities of this association to determine whether or not it had incorrectly reported the number of livestock handled. Hearings were held on February 14, 1924, and the examiner's findings on the basis of these hearings were issued on June 28, 1924. Exceptions were filed by the respondents on August 7, 1924, and the case was argued before the Secretary on August 21, 1924. The findings of the Secretary were as follows:

"It appears from the evidence that the number of head of livestock reported on the accounts rendered agreed with either the scale record or the loading or unloading count, and the evidence discloses that there was a discrepancy in each case between two of the records as to the number of head of hogs. Therefore, in rendering an account there was a difference between the number of head reported and the number of head shown on one or the other of these records. It appears, however, that the weight was reported correctly in accordance with the scale ticket. Normally the count recorded on the scale ticket is reliable and consequently should be adhered to and followed in accounting to shippers or purchasers of livestock, because the



count recorded on the scale tickets is made at the time title passes. It appears that at the time in question the respondent used the loading or unloading count, as the case might be in some instances in stating the number of head of livestock on the accounts rendered. These discrepancies occurred in the formative period of its business when it was developing with extraordinary rapidity and was exceptionally large for an organization of its then limited size and experience. But it appears that for some time prior to this inquiry and at the present time the respondent has been reporting to shippers or purchasers uniformly on the basis of the record as shown on the scale ticket, the count shown by which is checked by respondent's employees at the time it is made."

The case was dismissed by the Secretary on September 22, 1924.

*Docket No. 76.*—Farmers Educational and Cooperative State Union of Nebraska; Farmers Union Livestock Commission, and C. H. Withey, Union Stockyards, South Omaha, Neb.

An inquiry was ordered by the Secretary on January 11, 1924, into the activities of the respondents to determine whether they had rendered correct account sales and whether they had refunded and remitted to consignors or shippers of livestock a portion of the commission charges for selling their livestock, in violation of the packers and stockyards act. A hearing was set for this case but on May 21, 1924, the respondents admitted the truth of the charges set forth in the complaint. A cease and desist order was issued by the Secretary on August 27, 1924.

*Docket No. 78.*—Middlesworth Commission Co., Indianapolis, Ind.

On January 25, 1924, the Secretary ordered an inquiry into the business of this commission company to determine whether it had violated the packers and stockyards act by rendering incorrect account sales and charging a different compensation than that prescribed in its schedule. The facts were admitted on July 7, 1924. A cease and desist order was issued by the Secretary on August 27, 1924.

*Docket No. 80.*—Southern Stock Yards Corporation, Richmond, Va.

On February 20, 1924, the Secretary instituted an inquiry into the activities of this corporation to determine whether it had violated the packers and stockyards act by charging a different compensation for services than that specified in its schedule, and by rendering

incorrect account sales. Practices complained of were generally admitted on March 12, 1924. A hearing was held on May 26, 1924. Examiner's findings were issued on June 23, 1924, in which it was recommended that a cease and desist order be issued. Such an order was issued by the Secretary on August 27, 1924.

*Docket No. 81.*—Minnesota Pig and Cattle Co. v. The Central Cooperative Commission Association, South St. Paul, Minn.

On February 19, 1924, the Minnesota Pig and Cattle Co. filed a complaint with the Secretary that the Central Cooperative Commission Association had refused to sell pigs to it and had either sold or weighed up and sold without competition substantially all pigs consigned to it. A motion by the respondent that the complaint be dismissed and other motions were denied by the Secretary in an order issued on March 31, 1924. A hearing was commenced in this proceeding on April 14, 1924, and was adjourned April 17 for the purpose of having an audit made. In a petition dated June 12, 1924, the complainant asked leave to amend its complaint. A further hearing in this proceeding was held on July 8, 1924. On August 31, 1925, the complainant indicated that the conditions complained of no longer existed and that he did not desire to participate further in the matter. Accordingly, upon review, the Secretary ordered the case dismissed without prejudice on October 17, 1925.

*Docket No. 82.*—Spokane Union Stock Yards, Spokane, Wash.

This case grew out of the filing on February 18, 1924, of a schedule by the Spokane Union Stock Yards Co., providing for an increase in its yardage charges. A hearing was held on April 28, 1924, and the examiner's findings were issued on May 19, 1924. The examiner found that the proposed increase was reasonable and the Secretary on July 12, 1924, made the following findings:

1. That the respondent has operated at a loss, and no dividends have been paid on its common or preferred stock since the organization of the company.
2. That the proposed increases are necessary for the purpose of paying expenses of operation including interest on fixed liabilities.

The Secretary finds and is of the opinion from the evidence that the proposed increases as provided for in supplement No. 3 to tariff No. 1 of the respondent are not unjust or unreasonable.



*Docket No. 83.*—Barefoot Livestock Commission Co. and other market agencies at Oklahoma City, Okla.

Acting in accordance with a complaint made by the Oklahoma Livestock Exchange, on behalf of its market agency members, against the Bolinger-Spencer Livestock Commission Co., that the commission rates charged by the Bolinger-Spencer Co. were too low, the Secretary on February 29, 1924, issued an order of inquiry into the reasonableness of all rates and charges for buying and selling livestock at the Oklahoma City market. Hearings were held on April 8, 1924. The examiner issued his findings on July 21, 1924, to which exceptions were filed on October 3, 1924. This case is pending.

*Docket No. 85.*—John Clay & Co., Union Stockyards, Chicago, Ill.

On March 20, 1924, the Secretary issued an order of inquiry to determine whether John Clay & Co. had been guilty of rendering false account sales and selling to fictitious persons. An answer denying the allegations was filed by the respondent on April 9, 1924, and a hearing was held on July 26, 1924. The examiner issued his recommendations on October 31, 1924, to which exceptions were filed on December 11, 1924. The examiner recommended that the Secretary issue a cease and desist order forbidding the respondent to render incorrect account sales, and weighing up livestock to itself. The case was dismissed by the Secretary on March 3, 1925, for the reason that the evidence was insufficient to sustain the charges contained in the complaint.

*Docket No. 87.*—Nashville Union Stock Yards (Inc.), Nashville, Tenn.

On October 11, 1923, the Nashville Union Stock Yards Co. filed a supplement to its tariff No. 6 increasing the price of corn. An order was issued by the Secretary on March 31, 1924, directing that an inquiry be made into the reasonableness of the charges made for corn. A hearing in this proceeding was originally directed to be held on April 17, 1924, but was postponed until May 28, 1924. An amended order of inquiry, directing that the reasonableness and lawfulness of all charges provided for in respondent's tariff be investigated, was issued by the Secretary on April 30, 1924. A hearing was held on June 16, 1924, at Nashville. As a result of this hearing it was found that the earnings were not such as to make the rates unreasonable and the Secretary dismissed the pro-

ceedings without prejudice on September 14, 1925.

*Docket No. 88.*—Farmers Educational and Cooperative State Union of Nebraska, trading as Farmers Union Livestock Commission, South St. Joseph, Mo.

An inquiry was ordered by the Secretary on March 31, 1924, to determine whether or not this company had failed to account correctly the weight and price of livestock and expenses connected in handling it; whether it had failed to account correctly for the livestock sold by it; whether it had failed to account correctly on the individual account sales rendered by it in the matter of price at which the bulk of the livestock contained in plural ownership consignments was sold; whether it had failed to advise the consignor or shippers correctly as to the exact number of animals sold for them; whether it had failed to advise consignors or shippers that their livestock was sold to a buyer in whose business the company was financially interested; whether it had failed to advise consignors or shippers of the name of the buyer of their livestock; and whether it had refunded or remitted a portion of its commission charges to consignors or shippers who were not members of this market agency. A hearing was set for May 23, 1924, but on May 21 this organization admitted the truth of the charges set forth in the complaint. A cease and desist order was issued by the Secretary on August 27, 1924.

*Docket No. 89.*—Rice & Whaley Co., Buffalo Stockyards, Buffalo, N. Y.

The Secretary on March 31, 1924, issued an order of inquiry to determine whether H. G. Whaley, trading and doing business as Rice & Whaley, had rendered untrue accounts sales and had failed to keep complete copies of accounts sales, which it should have done in order to disclose fully and correctly all transactions involved in its business. On April 4, 1924, the respondents submitted an answer making a general denial of the allegations contained in the complaint. The facts were later admitted and an oral hearing waived. A cease and desist order was issued on March 16, 1925.

*Docket No. 90.*—Producers Cooperative Commission Association (Inc.), Buffalo, N. Y.

On March 31, 1924, the Secretary ordered an inquiry and investigation be instituted for the purpose of determining whether this cooperative commis-

sion association had engaged in the practice of entering sales upon its records to fictitious persons with the purpose of weighing up the shipment to itself, and whether it had engaged in the practice of charging a different compensation for its services than specified in the schedule. On March 7, 1924, the respondent admitted the facts alleged in the complaint. A cease and desist order was issued on July 12, 1924.

*Docket No. 91.*—Stacy, Bement & Beadle (Inc.), Buffalo Stock Yards, Buffalo, N. Y.

Under date of March 31, 1924, the Secretary ordered that an inquiry and investigation be held for the purpose of determining whether this company had violated the packers and stockyards act in that it had advised shippers that it had weighed up livestock to itself when as a matter of fact the livestock was sold to another; that it had reported to shippers that the livestock was sold at a higher price than that at which it was actually sold; and that it reported to shippers the names of persons as purchasers who were not the true purchasers. Respondents admitted the facts in the case. A cease and desist order was issued on March 16, 1925.

*Docket No. 92.*—South St. Joseph Live Stock Exchange of South St. Joseph, Mo., v. Farmers Union Live Stock Commission of South St. Joseph, Mo.

The South St. Joseph Live Stock Exchange filed on February 23, 1924, with the Secretary a complaint alleging that the live stock commission had violated the packers and stockyards act in the distribution of its excess profits. An answer in denial was filed April 11, 1924, and amended on May 23, 1924. A hearing was held beginning May 23, 1924. The examiner issued his findings on July 11, 1924 recommending that a cease and desist order be issued. The respondents filed exceptions to this on August 6, 1924, and the complainants filed exceptions. The case was dismissed on September 3, 1924, on the basis of the opinion and findings as follows:

The Secretary of Agriculture is of the opinion and finds (1) that the St. Joseph Stockyards at South St. Joseph, Mo., is a stockyard within the meaning of the packers and stockyards act, 1921, and was duly posted accordingly by the Secretary of Agriculture on November 1, 1921; (2) that the Farmers Union Livestock Commission is the trade name under which the Farmers Educational and Cooperative State Union of Nebraska was engaged in the operation of a market agency at the St. Joseph stockyards, South St. Joseph, Mo., at the times in question, and that the Farmers Educational and Cooperative State Union of Nebraska was registered accordingly under the packers and stockyards act; (3) that the only persons who are members thereof are those who are eligible to membership

under its charter and who have secured membership therein in accordance therewith; (4) that the Farmers Educational and Cooperative State Union of Nebraska is a cooperative association of producers within the meaning of the packers and stockyards act, inasmuch as it is substantially composed of and controlled by producers; (5) that the Farmers Educational and Cooperative State Union of Nebraska has made refunds of a portion of its commissions on livestock to shippers thereto who were not, under its charter, members thereof; (6) that inasmuch as all of the questions involved in this case were involved in said docket No. 88 with reference to which a cease and desist order has been issued, except the question whether the defendant herein is a cooperative association of producers within the meaning of the packers and stockyards act, no order to cease and desist should be issued herein.

*Docket No. 93.*—C. F. Noble, trading and doing business as Coulbourn & Noble, West Philadelphia Stock Yard, Philadelphia, Pa.

On April 3, 1924, the Secretary issued a complaint in which it was alleged that the respondent had rendered incorrect account sales and had overpaid certain shippers and had underpaid other shippers, and that he had sold hogs to a corporation in which he held stock without disclosing to the owners of the hogs that he had a pecuniary interest in the corporation. On April 7, 1924, the respondent submitted an explanation with respect to the matters and things set forth in the complaint. Subsequent thereto an investigation was made which disclosed that following the issuance of said order for investigation and hearing said respondent had changed its methods and discontinued the practice complained of. The Acting Secretary of Agriculture on May 27, 1925, dismissed the complaint without prejudice.

*Docket No. 95.*—Farmers Union Live Stock Commission, Union Stock Yards, South Omaha, Nebr.

On April 8, 1924, the Secretary on his own motion ordered an investigation to determine whether or not this market agency had violated the packers and stockyards act by illegally refunding or remitting a portion of its commission charges. Answer was filed on April 14, 1924, and the facts were admitted on May 21, 1924. Hearing was waived and a cease and desist order was issued on August 27, 1924.

*Docket No. 96.*—Farmers Union Live Stock Commission Sioux City Stock Yards, Sioux City, Iowa.

On April 15, 1924, the Secretary instituted an inquiry for the purpose of determining whether the Farmers Union Live Stock Commission, doing business at the Sioux City Stock Yards, had unlawfully refunded or remitted a portion of its rates and charges specified in its schedule in violation of the packers and stockyards act. On April



19, 1924, an answer was filed, and on May 21, 1924, some of the facts complained of were admitted by the respondent and hearing waived. A cease and desist order was issued on August 27, 1924.

*Docket No. 97.*—Roberts & Oake, v. The Union Stock Yard & Transit Co., Chicago, Ill.

This was a proceeding instituted by the Secretary based upon the complaint made by Roberts & Oake against the Union Stock Yard & Transit Co., or Chicago. The complaint alleges that the defendant failed to render to the complainant reasonable stockyard services without discrimination and that it resorted to unfair and unjustly discriminatory practices in connection with the holding, delivering, and handling of livestock in commerce. The defendant denied informally the allegation. A hearing was held on May 5, 1924, to which exceptions were filed by the respondent on June 16, 1924. The case was argued before the Secretary on July 21, 1924, at Des Moines, Iowa. The case was dismissed on April 30, 1925, but the defendant was directed by the Secretary to pay to the complainant \$35.10 as reparation on account of damages sustained, due to misdelivery of hogs on March 6, 1924. The opinion of the Secretary follows:

The respondent in this proceeding challenges the jurisdiction of the Secretary of Agriculture under the law to make or order reparation in this case and moves to dismiss the complaint.

It is asserted that the respondent's practice is neither unfair, unreasonable, nor discriminatory, and that complainant's damage, even if it results from a breach of respondent's duty, is not such that reparation therefor can be awarded by the Secretary of Agriculture under Title III of the packers and stockyards act, 1921. The issue in the case is to be decided, of course, upon whether the reparation claimed in this case is for damages suffered in consequence of a violation by respondent of the provisions of Title III of the packers and stockyards act, 1921.

While the complaint is grounded upon specific instances of misdelivery of complainant's livestock and it is alleged that these acts are an unfair and unjustly discriminatory practice, there is also a more general allegation that respondent has failed to render to complainant a reasonable service without discrimination required by section 307 of the act. Disregarding any formal defects from the standpoint of technical pleading in the complaint and irrespective of whether the acts complained of in themselves constitute discrimination, there is presented for my determination in this proceeding the following issues: Is respondent's practice unjust, unreasonable or discriminatory in any respect or to any extent? If so, has complainant suffered any damage thereby so as to be entitled to reparation under the terms of the act? Upon the pleading and evidence and the facts disclosed by the record in this case I conclude that there is jurisdiction in the Secretary of Agriculture to entertain this complaint and upon the merits find that the damages alleged in the complaint were suffered by complainant in consequence of a violation of Title III of the packers and stockyards act by respondent; no order to cease and desist on the present record should be issued at this time, and this phase of the complaint should be dismissed without prejudice.

*Docket No. 98.*—Donahue Bros. (Inc.), Union Stockyards, South Omaha, Nebraska.

On April 23, 1924, the Secretary ordered that an inquiry and investigation be instituted for the purpose of determining whether Donahue Bros. (Inc.), had violated the packers and stockyards act in that it had so disposed of funds in its possession or control as to endanger the prompt accounting for payment of the proceeds due owners of livestock by intermingling its own personal accounts with those of shippers and consignors of livestock; by crediting the net proceeds of the sale of livestock to its estray account or other personal account instead of remitting such proceeds promptly to the shipper; and by rendering incorrect account sales to owners and consignors.

An answer was filed on June 10, 1924, denying most of the allegations in the complaint. A hearing was held on July 24, 1924, and the examiner's recommendations were issued on August 28, 1924, to which no exceptions were filed. A cease-and-desist order was issued by the Acting Secretary on November 21, 1924.

*Docket No. 99.*—Ransom, Mansfield & Co., Buffalo Stockyards, Buffalo, N. Y.

On April 23, 1924, the Secretary instituted an inquiry on his own motion and ordered a hearing to determine whether this firm had violated the packers and stockyards act by reporting to shippers in crediting to them the names of persons as purchasers who were not the true purchasers of their livestock. The facts were admitted on March 9, 1925, and a cease and desist order was issued on March 16, 1925.

*Docket No. 100.*—Swope, Hughes, Waltz & Benstead Commission Co., Buffalo Stockyards, Buffalo, N. Y.

The Secretary on April 23, 1924, ordered that an inquiry and investigation be begun for the purpose of determining whether this firm had violated the packers and stockyards act by reporting to shippers and accounting to them the names of persons as purchasers who were not the true purchasers of their livestock; by accounting to shippers on the basis of sale prices for their livestock, which were not the true prices actually received; and by failing to disclose to consignors that said livestock was sold to a person in whom the respondent had a pecuniary interest. These facts were admitted on March 9, 1925. A cease and desist order was issued on March 16, 1925.



*Docket No. 101.*—Minnesota Pig & Cattle Co. v. The Central Cooperative Commission Association, South St. Paul, Minn.

On April 14, 1924, the Minnesota Pig & Cattle Co., filed a complaint against the Central Cooperative Commission Association of South St. Paul, alleging that the respondent had been engaging in unfair, unjustly discriminatory, and deceptive practices and devices in connection with receiving, marketing, buying, and selling livestock on a commission basis, and also in feeding, weighing, and handling livestock in South St. Paul. A hearing was held in this case on July 9, 1924, but was adjourned before any evidence was presented. On August 31, 1925, the complainant indicated that he did not desire to participate further in the matter. Accordingly, upon review, the Secretary ordered the case dismissed without prejudice on October 17, 1925.

*Docket No. 103.*—Heilbron & Loeb, West Philadelphia Stockyard, Philadelphia, Pa.

On April 25, 1924, the Secretary instituted an inquiry on his own motion and issued an order for investigation to determine whether or not this firm in rendering account sales to owners or consignors of livestock had failed truly and correctly to state the name of the purchaser of their livestock; whether this firm had rendered incorrect account sales to owners or consignors of livestock; and whether it had submitted incorrect and untrue reports to the Secretary under the packers and stockyards act as to the financial condition of its business. The facts were admitted on July 17, 1924. A cease and desist order was issued on August 27, 1924.

*Docket No. 104.*—St. Joseph Livestock Commission, St. Joseph Stockyards, South St. Joseph, Mo.

On April 30, 1924, the Secretary instituted on his own motion an inquiry and issued an order for investigation of this firm to determine whether or not it had engaged in speculating in livestock received for sale without the knowledge and consent of the owners or consignors; whether it had failed to inform owners or consignors that it had weighed up or sold their livestock to itself; whether it had sold livestock received for sale to a person with whom it had an agreement to share in profits that might be derived from this transaction without the knowledge and consent of the consignors or owners thereof; whether it had failed to advise the owners or consignors that

their livestock had been sold to a buyer in whose business the firm had a pecuniary interest; whether it had failed to account to owners or consignors for the entire amount received for their livestock; whether it had failed to render true and correct account sales covering livestock sold by it for the owners or consignors; whether it had misrepresented to the owners or consignors of livestock the prices received therefor; and whether it had failed to inform the owners or consignors of the names of the purchasers of their livestock. The facts complained of were admitted on May 28, 1924, and a cease and desist order was issued on August 27, 1924.

*Docket No. 105.*—William G. Gross, West Philadelphia Stockyards, Philadelphia, Pa.

On May 2, 1924, a notice of inquiry was issued against William G. Gross to determine whether he had been guilty of violation of the packers and stockyards act. On May 20, 1924, the respondent made an explanation of his activities. It appeared that he had canceled his registration under the packers and stockyards act as a market agency on September 1, 1923, and on that date he had registered under this act as a dealer, and that the transactions referred to in the proceeding had occurred prior to this date. For this reason the complaint was dismissed without prejudice on July 12, 1924, with the reservation that an inquiry might be issued in the event that Gross again operated as a market agency.

*Docket No. 106.*—Fort Worth Stockyards Co., Fort Worth, Tex.

On April 16, 1923, the Fort Worth Stockyards Co. published a tariff requiring that commission firms or traders should furnish bond to the amount of at least \$5,000 to secure the obligations of commission firms and dealers to the owners or consignors of livestock. A protest signed by 57 dealers and 4 market agencies on this market was made to the Secretary on the grounds that the rule was in violation of the packers and stockyards act. At the hearing the interested parties indicated a willingness to give bond graduated according to the amount of business done and the responsibility assumed. The examiner made a recommendation to the Secretary in line with this agreement and the Acting Secretary of Agriculture ruled on May 15, 1925, that such an arrangement would be consistent with the bonding requirements of the administration and the case was dismissed without prejudice.

*Docket No. 107.*—Williamson & Dennis, National Stockyards, Jacksonville, Fla.

On May 6, 1924, the Secretary instituted an inquiry and issued an order that an investigation be made and that a hearing be held to determine whether this firm, among other things, had been charging and collecting a less commission for selling hogs and other livestock than that specified in the schedule; whether it was charging for services not specified in its schedule; whether it had failed to report in writing to the Packers and Stockyards Administration a change in management and the character of business; and in any other manner disclosed by the facts. On May 17, 1924, an acknowledgment and explanation was made. An order was issued on September 3, 1924, dismissing some of the complaint but directing that the company cease and desist from violation in respect to those points enumerated above.

*Docket No. 109.*—The Delmue Livestock Commission Co., Union Stockyards, North Salt Lake, Utah.

On May 24, 1924, the Secretary issued a complaint alleging that the respondent rendered an incorrect account sale charging a commission of \$18, notwithstanding the charges specified in his schedule filed and in effect at the time were only \$14.70. The respondent submitted in writing a satisfactory explanation of the matters and things referred to in said notice; an investigation thereof having been made which substantially corroborated the respondent's explanation, the Secretary of Agriculture, under date of February 9, 1925, ordered that this proceeding be dismissed without prejudice.

*Docket No. 110.*—National Livestock Commission Co., Union Stockyards, Chicago, Ill.

On May 24, 1924, the Secretary ordered an investigation and hearing to determine whether this firm had rendered untrue account sales. The respondents submitted in writing a satisfactory explanation of the practices complained of and a subsequent investigation substantially corroborated the same. The case was dismissed by the Secretary on February 9, 1925.

*Docket No. 111.*—The Hunsaker Livestock Commission Co., Union Stockyards, Ogden, Utah.

On May 24, 1924, the Secretary issued a complaint alleging that the respondent rendered incorrect account sales in which a different commission was charged from that specified in the

schedules filed and in effect at the time and the respondent rendered account sales showing initials only of purchasers in many instances. In certain instances the account sales were incorrect in that they showed that the livestock was sold at a different price from which they were actually sold. The respondent submitted in writing a satisfactory explanation of the matters and things referred to in said notice; an investigation thereof having been made which substantially corroborated the respondent's explanation, the Secretary of Agriculture, on February 9, 1925, ordered that this proceeding be dismissed without prejudice.

*Docket No. 112.*—Fisher Livestock Commission Co., Union Stockyards, North Salt Lake, Utah.

On May 24, 1924, the Secretary issued a complaint alleging that the respondent in two instances charged a larger commission for selling livestock than the charges specified in the schedules filed and in effect at the time. The respondent submitted in writing a satisfactory explanation of the matters and things referred to in said notice; an investigation thereof having been made which substantially corroborated the respondent's explanation, the Secretary of Agriculture, on February 9, 1925, ordered that this proceeding be dismissed without prejudice.

*Docket No. 113.*—Gant Livestock Commission Co., Union Stockyards South Omaha, Nebr.

On May 24, 1924, the Secretary instituted an inquiry and ordered an investigation and hearing to determine whether this firm had violated the packers and stockyards act by selling livestock at a price contingent upon the price which might be paid for other livestock, and in otherwise violating the packers and stockyards act. On May 31, 1924, explanations were submitted with respect to certain transactions set forth in the order of inquiry, the other facts were admitted, and an oral hearing was waived. On August 27, 1924, the company was ordered to cease and desist from selling livestock at a price contingent upon that at which other livestock was bought, and the other allegation was dismissed.

*Docket No. 114.*—E. J. Netherton v. St. Joseph Stock Yards Co., South St. Joseph, Mo.

On May 19, 1924, E. J. Netherton, a dealer in and feeder of livestock at St. Joseph, Mo., filed with the Secretary a complaint to the effect that the stockyards had imposed upon him



rates and charges for stockyards services which were unjust, unreasonable, and discriminatory, and that the stockyards had established and enforced unjust, unreasonable, and discriminatory regulations and practices in furnishing stockyards services. An acknowledgement and explanation was made by the stockyards company on June 5, 1924. On August 30, 1924 the complainant asked leave to withdraw the complaint and the case was dismissed by the Secretary on October 29, 1924.

*Docket No. 115.*—B. R. Wilkerson, Union Stock Yards, Denver, Colo.

On June 13, 1924, the Secretary ordered an inquiry and hearing to determine whether or not the respondent had violated the packers and stockyards act by engaging in the business of buying and selling livestock in commerce without registering as a market agency at the Denver Union Stock Yards. On August 12, 1924, the truth of the allegation was admitted and an oral hearing was waived. A cease and desist order was issued on August 27, 1924.

*Docket No. 116.*—St. Paul Union Stockyards Co. rate case.

On July 11, 1924, the Secretary issued an order directing that an inquiry and a hearing be held to determine the reasonableness of rates charged by the St. Paul Union Stockyards Co., for rendering stockyard services, naming August 7, 1924, as the date of the hearing. This hearing was postponed until September 30, 1924. Beginning on this date and continuing until October 17, 1924, the first hearing was held. The second hearing was held on November 17, 1924, and lasted until December 1, 1924. A third hearing was begun on July 21, 1925, and continued until August 8, 1925. A further hearing was held in this case from October 19 to October 26, 1925. The final hearing was held beginning December 8, 1925, in Washington, D. C. The respondents asked for 120 days in which to make an abstract of testimony. This was granted, and the case is now pending.

*Docket No. 117.*—The New York Stock Yards Co., New York, N. Y.

On July 12, 1924, the Secretary ordered an investigation and hearing to ascertain whether the stockyards company had violated the packers and stockyards act by charging and receiving pay for more hay and corn than it furnished patrons of the stockyards, and by failing to furnish to the livestock of patrons the amount of hay and corn

which was paid for by the patrons. The facts were admitted on August 8, 1924, and a cease and desist order was issued by the Secretary on August 27, 1924.

*Docket No. 118.*—C. C. Seal Commission Co., Union Stock Yards, Cincinnati, Ohio.

On July 12, 1924, the Secretary ordered an inquiry and hearing to determine whether this company doing business on the stockyards at Cincinnati, Ohio, had charged for stockyards services more than the rates specified in its schedule, and whether it had misrepresented to the owners and consignors of livestock the prices received for livestock. The facts were admitted on September 29, 1924, and a cease and desist order was issued by the Secretary on November 6, 1924.

*Docket No. 119.*—L. J. Budde Commission Co., Union Stock Yards, Cincinnati, Ohio.

On July 12, 1924, the Secretary ordered an investigation and hearing to determine whether this company had violated the packers and stockyards act by charging a less rate for stockyards services than that specified in the schedule which it had filed; whether they had misrepresented to the owners or consignors of livestock the prices received for it; and by rendering false account sales to owners and consignors. The facts were admitted on July 26, 1924, and a cease and desist order was issued on August 27, 1924.

*Docket No. 120.*—Norris Brock Co., Union Stock Yards, Cincinnati, Ohio.

On July 12, 1924, the Secretary ordered an investigation and hearing to determine whether this company had violated the packers and stockyards act by collecting different compensation for stockyards services from the rates specified in its schedule; whether it had misrepresented to owners or consignors of livestock the sale price received for the livestock; whether it had rendered false account sales to owners or consignors; and whether it had destroyed records and thus covered up its weigh-up account of hogs sold to itself prior to May 30, 1923, without the consent in writing of the officer in charge of the Packers and Stockyards Administration at Washington. The facts were admitted on July 22, 1924, and a cease and desist order was issued on August 27, 1924.

*Docket No. 121.*—The Crawford Commission Co., Union Stockyards, Cincinnati, Ohio.



On July 12, 1924, the Secretary instituted an inquiry on his own motion and ordered an investigation and hearing to determine whether this company, doing business in Cincinnati, Ohio, had collected a different rate of compensation for stockyards services from that set forth in its schedule filed with the Packers and Stockyards Administration; whether it had misrepresented to owners or consignors of livestock the sale price received therefor; and by rendering false or misleading account sales to the owners or consignors. The facts were admitted on July 21, 1924, and a cease and desist order was issued on August 27, 1924.

*Docket Nos. 122, 123, and 124.*—Nifong Commission Co., Independent Livestock Commission Co., J. E. Davis Livestock Commission Co., National Stockyards, Ill.

This case grew out of the fact that these commission companies filed schedules increasing commission rates. The Acting Secretary of Agriculture, on July 21, 1924, issued an order of investigation and hearing to determine the reasonableness of the increase. A hearing was held on August 11, 1924. These cases were later consolidated and made a part of docket No. 132.

*Docket No. 125.*—Henry Fox, Union Stockyards, Baltimore, Md.

On July 29, 1924, the Secretary issued an order directing an investigation and hearing of Henry Fox, operating as a market agency on the Union Stockyards at Baltimore, Md., to determine whether he had violated the packers and stockyards act in that he had directed and instructed his secretary and bookkeeper to render accounts purchased in the name of Henry Fox to the Greenwald Packing Corporation at higher prices than those received by the shippers of cattle; and whether he had failed to charge a shipper a proper commission as determined by his schedule for the selling of livestock; and whether the market agency had filed incorrect reports with the Secretary of Agriculture covering its financial condition at a given time. The examiner issued his findings on July 8, 1925, and a cease and desist order was issued by the Secretary on December 5, 1925.

*Docket No. 126.*—Myers & Houseman, Union Stockyards, Baltimore, Md.

On July 29, 1924, an investigation and hearing was ordered by the Secretary in order to determine whether the above firm, doing business as a corporation on the Union Stockyards at Bal-

timore, had been guilty of violating the packers and stockyards act in underpaying a shipper and failing correctly to describe the name of the purchaser; whether the company had failed to charge and collect from the shipper the rate specified in its schedule of rates and charges filed with the packers and stockyards administration. On August 7, 1924, this company filed an answer making satisfactory explanation, from which it appeared that the alleged violations were the result of errors. Subsequent investigation substantiated the explanation. On this basis the case was dismissed on the 1st of December, 1924.

*Docket No. 127.*—Samuel Sundheimer, Union Stockyards, Baltimore, Md.

On July 29, 1924, an order was issued by the Secretary directing an investigation and hearing against Samuel Sundheimer, registered as a market agency operating at the Union Stockyards in Baltimore, to inquire whether he had violated the packers and stockyards act by remitting a portion of its commission charges for selling livestock. On August 6, 1924, the respondent filed an answer stating that the person to whom the refund was made was not the owner of the livestock, and that the persons to whom the refunds were alleged to have been made were employees of the market agency. Subsequent to the filing of the answer a further investigation was made which substantiated the answer filed. On this basis the case was dismissed by the Acting Secretary of Agriculture on October 15, 1924.

*Docket No. 128.*—Waitt & Lake Commission Co., Sioux City Stockyards, Sioux City, Iowa.

On August 29, 1924, the Secretary directed that an investigation and hearing be held to determine whether this company had acted in violation of the packers and stockyards act in that it failed to make a commission charge for the selling of livestock. On September 6, 1924, these transactions were explained to the satisfaction of the Secretary and on January 22, 1925, the case was dismissed.

*Docket No. 129.*—E. A. Blackshere & Co., Union Stockyards, Baltimore, Md.

On August 29, 1924, the Secretary issued an order directing that an investigation be made and that a hearing be held to determine whether this company had violated the packers and stockyards act in that it had paid to shippers prices for livestock greater

than those for which the livestock had been sold. On February 3, 1925, the respondents and other market agencies, operating in the Union Stockyards at Baltimore, Md., agreed in writing to remit to shippers strictly on the basis of the prices received for their livestock. The practice complained of being thus eliminated, the Acting Secretary of Agriculture dismissed the case on March 5, 1925.

*Docket No. 130.*—Theodore B. Landis, West Philadelphia Stockyards, Philadelphia, Pa.

On September 3, 1924, the Secretary ordered an investigation and hearing to determine whether the respondent had violated the packers and stockyards act in rendering incorrect account sales to owners and consignors of livestock which failed truly and accurately to state the name of the purchaser of the livestock and in rendering incorrect account sales to the owners or consignors of livestock, and by selling livestock to persons in whose business the respondent had a pecuniary interest, without disclosing such facts to the owner of the livestock. On November 11, 1924, the respondent admitted the allegations and waived an oral hearing, and on November 21, 1924, the Acting Secretary issued a cease and desist order.

*Docket No. 131.*—Newark Stockyards, Kearny, N. J.

The Newark Stockyards Co., having filed a schedule raising rates for stockyards services, the Secretary on September 24, 1924, suspended the schedule and ordered an investigation and hearing to determine the reasonableness of these rates. On September 27, 1924, the respondent made a request to withdraw the tariff. The case was dismissed on October 1, 1924.

*Docket No. 132.*—Alexander, Conover & Martin, and other market agencies operating at the National Stockyards, Ill.

On October 10, 1924, the Secretary ordered an investigation and hearing to determine the reasonableness of commission rates charged by the respondents. A hearing was held on March 24, 1925. This case is pending.

*Docket No. 133.*—Armour & Co. of Illinois, Armour & Co. of Delaware, North American Provision Co., Swift & Co., Chicago, Ill.

The history of this case and the action taken is set forth in the statement of the case in the Secretary's order of January 22, 1925, as follows:

#### PROCEEDINGS

This is a proceeding which involves the question whether the respondents herein have violated the provisions of Title II of the packers and stockyards act, 1921, with respect to their purchases of hogs at the Union Stockyards at Chicago, Ill.

On October 14, 1924, a complaint and notice was issued by the Secretary of Agriculture, containing charges that the respondents had engaged in and used an unfair and unjustly discriminatory practice and otherwise violated the packers and stockyards act, 1921, as set out in the said complaint. Without repeating the whole of said complaint, to which reference is made for its contents, it was based substantially upon the allegation that the respondents in or about the month of September, 1924, ceased and refused to do business with, or to purchase hogs handled by, any and all traders in the Union Stockyards at Chicago, Ill., and that the respondents were restricting and confining their purchases in said yards to hogs purchased directly from commission men which had not previously been purchased or handled by any trader. Notice was given to the respondents that they might file their answers to this complaint on or before the 20th day of November, 1924, and that a hearing would be held for the purpose of investigating the matters and things set forth in the complaint beginning on December 1, 1924, at Chicago, Ill., in which hearing the respondents would have the right to appear and show cause why an order should not be made requiring them to cease and desist from violating Title II of the packers and stockyards act. The issuance of this complaint and notice followed the receipt and preliminary investigation of a complaint filed by a committee representing the traders engaged in handling hogs at the Union Stockyards at Chicago, Ill. Upon agreement of the complaining traders and the respondents the date of the hearing was, on November 19, 1924, postponed to December 8, 1924.

On November 26, 1924, Swift & Co., one of the respondents, filed a written answer, denying violation of the packers and stockyards act.

On December 3, 1924, the Armour respondents and the committee representing the complaining traders appeared before the examiner. It was stated by counsel representing the Armour respondents that they would like to have the matter disposed of without further hearing. It appeared that at the suggestion of the Armour respondents a meeting had been held previously with the committee representing the traders and that a satisfactory understanding had been reached between them as to the matters and things involved in the complaint. Counsel for the Armour respondent stated that the basis of the understanding was that the Armour respondents will in the regular course of their business purchase hogs on the Chicago market on their merits, irrespective of whether owned by traders or in the hands of commission men or traders, the buyers of the Armour respondents having received such information as is customarily required, trader hogs to be identified as such when offered, and the owners of trader hogs to be disclosed when requested; it being explained that this condition was made so that the buyer may know that he is buying resold hogs but not for the purpose of discriminating against the trader as to value or price because of ownership.

It was announced by the committee representing the complaining traders that the statement and explanation on behalf of the Armour respondents were satisfactory.

It was thereupon stated on behalf of the Packers and Stockyards Administration that the matter would be submitted to the Secretary of Agriculture for consideration and such action as he might decide.

On December 6, 1924, counsel for Swift & Co., and the committee representing the complaining traders appeared before the examiner. Counsel for Swift & Co., stated that it will be the policy of Swift & Co., to buy hogs at the Chicago market on their merits and in the regular course of its business, regardless of their ownership, provided the identity and ownership of the hogs offered for sale are disclosed and such other information is given to its



buyers as is customarily required. Counsel for Swift & Co., further stated that it is understood that the carrying out of such policy is subject to and dependent upon the dismissal of the said complaint without prejudice to the legal rights of the parties. It was also stated by counsel for Swift & Co., that the phrase "regardless of ownership," as used in the foregoing statement, may be interpreted to mean irrespective of whether owned by traders or in the hands of commission men or otherwise. The committee representing the traders announced that the statement on behalf of Swift & Co. was satisfactory to the traders. It was thereupon stated on behalf of the Packers and Stockyards Administration that the matter would be submitted to the Secretary of Agriculture for consideration and appropriate action.

#### ORDER

*Now therefore, upon consideration of the entire record, including the matters hereinbefore set out, and subject to the condition that the said policies announced by the counsel for the respondents are carried out.*

*It is ordered that the complaint in this proceeding be dismissed without prejudice.*

*Docket No. 134.*—J. L. Bush Union Stockyards, Denver, Colo.

On November 21, 1924, the Acting Secretary instituted an inquiry and issued an order for investigation and hearing to ascertain whether the respondent had violated the packers and stockyards act by misrepresenting to the producers of livestock the price which the respondent had paid for it. Acknowledgement by the respondent in writing of the truth of the allegations in the complaint was made on December 3, 1924, and a cease and desist order was issued on January 13, 1925.

*Docket No. 135.*—William H. Becker, trading and doing business as The Becker Commission Co., National Stockyards, East St. Louis, Ill.

On January 13, 1925, the Acting Secretary ordered an investigation and hearing to determine whether the respondent had violated the packers and stockyards act by rendering false or misleading account sales to owners or consignors of livestock received for sale; by rendering account sales to owners or consignors which did not give the correct names of the purchasers of livestock; by rendering account sales to owners or consignors which failed fully and correctly to disclose all facts covering the sale of their livestock; and by weighing to his account livestock consigned to him for sale in his capacity as a market agency without disclosing this fact to the owners or consignors of the livestock. On March 14, 1925, the respondent admitted the truth of the allegations of the complaint and waived an oral hearing. A cease and desist order was issued on May 13, 1925.

*Docket No. 136.*—The American Livestock Commission Co., and others,

National Stockyards, Oklahoma City, Okla.

On May 18, 1925, an order of inquiry and a hearing was ordered by the Secretary to determine whether the respondents, market agencies and dealers, had individually and in concert engaged in and used unfair and unjustly discriminatory practices and devices in connection with the buying and selling of livestock in commerce, for the purpose of driving out of business the Producers' Commission Association and the Bolinger & Spencer Livestock Commission Co., market agencies at the Oklahoma National Stockyards. A hearing on this complaint was held beginning June 29, 1925. The examiner issued his findings on December 9, 1925, and exceptions were filed by the respondents. The case was argued before the Secretary on February 18, 1926, and is now pending.

*Docket No. 137.*—L. Levy Livestock Commission Purchasing Co., Kansas City, Mo.

On June 29, 1925, the Acting Secretary issued an order of investigation to determine whether the respondent had engaged in unfair and deceptive practices in connection with the rendering of incorrect account purchases. It appeared from further investigation in this case that the matters and things set forth in the notice of inquiry were the result of errors and were not indicative of a practice. The case, therefore, was dismissed on November 25, 1925.

*Docket No. 138.*—John L. McHugh, Union Stockyards, Chicago, Ill.

A hearing was held on July 20, 1925, based on charges of insolvency. The report of the examiner was issued on August 7, 1925, recommending that the respondent be suspended. On October 31, 1925, the Secretary issued an order suspending the respondent from registration for six months.

*Docket No. 139.*—James J. O'Connor, Union Stockyards, Chicago, Ill.

A hearing was held on July 20, 1925, based on charges of insolvency. The examiner's report to the Secretary was made on August 7, 1925, in which it was recommended that the respondent be suspended. On October 31, 1925, the Secretary of Agriculture issued an order suspending the respondent for a period of six months.

*Docket No. 140.*—Chicago Producers' Commission Association, Union Stockyards, Chicago, Ill.

On August 1, 1925, the Secretary instituted an inquiry on his own motion



and issued an order for investigation and hearing to ascertain whether the Chicago Producers' Commission Association, a market agency, had violated the packers and stockyards act by charging shippers for more corn and hay than it bought from the Chicago Union Stockyards & Transit Co., and thus rendered account sales to shippers which were incorrect. On August 8, 1925, the respondent acknowledged in writing service of a copy of the order, admitted the matters and things set forth therein, and waived an oral hearing thereon. A cease and desist order was issued by the Secretary on October 21, 1925.

*Docket No. 141.*—C. Olin Long, Kansas City Stockyards, Kansas City, Mo.

On February 4, 1926, the Acting Secretary issued an order for investigation and hearing to determine whether the respondent is insolvent. The case is now pending.

*Docket No. 142.*—The Chicago Producers Commission Association; Rankin Shefler; Thomas P. Evans; S. E. Williamson; John J. Airey; and A. Shapiro, Union Stockyards, Chicago, Ill.

On December 5, 1925, the Secretary on his own motion issued an order for investigation and hearing to determine whether the respondents had violated the packers and stockyards act by making certain adjustments with shippers of livestock resulting in the practice of making unlawful refunds, and by entering into collusive arrangements with reference to the sale of livestock consigned by shippers for sale on the open competitive market. An answer was filed on January 7, 1926. Hearings were held beginning February 3, 1926. The respondent appeared before the Secretary to make oral argument on February 27, 1926. On March 6, 1926, the Secretary issued the following orders:

*It is therefore ordered* that the Chicago Producers Commission Association cease and desist from continuing violations of said act (1) by refunding or remitting in any manner any portion of the rates or charges specified in its schedule on file and in effect at the time (but this shall not prohibit it from bona fide returning to its members, on a patronage basis, its excess earnings on their livestock, subject to such regulations as the Secretary may prescribe); (2) by entering into any collusive arrangement or agreement by or through any of its officers, agents, or employees with any respondent dealer named herein or any other person, by which undue and unjust preferences or advantages in the sale of hogs or other livestock are given to anyone in the manner or form as alleged in the order of inquiry or in any other manner or form.

*It is further ordered* that the respondent, Chicago Producers Commission Association, be, and it is hereby, suspended from registration as a market agency for a period of 30 days.

*It is therefore ordered* that Rankin Shefler, Thos. P. Evans, S. E. Williamson, and J. P. Reilly cease and desist from continuing, in violation of the packers and stockyards act, 1921, to engage in or use any unfair, unjustly discriminatory, or deceptive practice or device in connection with the receiving, marketing, buying, or selling of livestock in commerce at a stockyard by entering into collusive or other sales, purchases, agreements, or arrangements with the Chicago Producers Commission Association or any other party wherein or whereby any undue and unjust preference or advantage is given or received in buying and selling hogs or other livestock in commerce, or in any other manner disclosed by the facts as set forth in said inquiry.

*It is further ordered* that Rankin Shefler, Thos. P. Evans, S. E. Williamson, and J. P. Reilly be, and each of them is hereby, suspended as registrants under the packers and stockyards act, 1921, for five years.

*Docket No. 143.*—American Livestock Commission Co.; Lou Bick Commission Co.; Bliss & Son; Bliss, Wellman & Hopkins; Boetel Livestock Commission Co.; Bowles Livestock Commission Co., of Omaha; and other members of the Omaha Livestock Exchange et al., Union Stockyards, Omaha, Nebr.

On January 16, 1926, the respondents published a tariff, effective January 26, 1926, stating a new schedule of rates and charges for buying and selling livestock. The charges as set forth in this schedule are greater than those under the one in force at the time of the filing of the increased rates. On January 25, 1926, the Secretary of Agriculture issued an order suspending this tariff for a period of 30 days beyond the time when it would otherwise go into effect, and directing an investigation and hearing to determine the reasonableness of the proposed commission rates. By order of the Acting Secretary on February 20, 1926, this tariff was suspended for an additional 30-day period and a hearing was set for March 25, 1926.

*Docket No. 144.*—Charles H. Stief, jr., National Stockyards, Ill.

On January 26, 1926, the Acting Secretary issued an order for investigation and hearing to determine whether the respondent was insolvent. On March 11, 1926, the Acting Secretary issued an order suspending the respondent for one year.

*Docket No. 145.*—James Kane, Milwaukee Stockyards, Milwaukee, Wis. On February 3, 1926, the Acting Secretary ordered an investigation and hearing to determine whether the respondent is insolvent. The case is now pending.

*Docket No. 146.*—Morris Fromson, Cleveland Union Stockyards, Cleveland, Ohio.

On February 6, 1926, the Acting Secretary issued an order for investi-

gation and hearing to determine whether the respondent had violated the packers and stockyards act in unlawfully getting possession of sheep in the Cleveland Stockyards. A hearing was held on February 12 and 13, 1926. On March 12, 1926, the Acting Secretary issued a cease and desist order and in addition the respondent was suspended for a period of one year.

### SPECIFIC INFORMATION REQUESTED BY THE RESOLUTION

The foregoing is a general report and embraces the subjects treated in previous annual reports. The resolution requests that certain specific matters be incorporated in this report. Appropriate reference is here made to the various sections of this resolution.

(A) A description of the present organization for the administration and enforcement of the packers and stockyards act is given in the first part of this report.

(B) The packers have been required to furnish reports annually, giving certain general information with reference to their business. The report for the calendar year 1924 was required to cover the following:

(1) Balance sheets at the beginning and at the end of the last fiscal or calendar year 1924.

(2) A statement analyzing the surplus account in adjustment with the balance sheets.

(3) A copy of the profit and loss statement covering the same period, with the following shown as separate items and not included in other items in the classification:

(a) Net sales, divided so as to show domestic sales, exports sales, and foreign sales from foreign slaughter separately; this item should include only net sales to outsiders, which are concerns other than any subsidiaries included in the report. (Indicate whether freight expense is included in this item.)

(b) Interest received.

(c) Open and closing inventories.

(d) Purchases and cost of goods manufactured and sold. (Indicate whether freight expense is included in this item.)

(e) Interest paid.

(f) Depreciation.

(g) Income tax, specifying period covered and separating current year from prior years, if both included.

It was required that reports including the operations of subsidiaries should show their names and addresses and that the report of a subsidiary should show the name and address of the parent concern.

For the year 1925 the following additional information was required:

1. State general character of business conducted, listing, by classes, the principal products: -----

2. Are operations conducted under Federal inspection? -----

3. Do you purchase livestock for slaughtering purposes? ----- If so, state:

(a) Number of head—Cattle ----- calves -----  
hogs ----- sheep and goats ----- purchased from public stockyards market (give names of markets) -----

(b) Number of head: Cattle ----- calves -----  
hogs ----- sheep and goats ----- purchased from country (show territory, by States, from which supply is drawn) -----

4. State the number of head slaughtered for your own account: Cattle ----- calves ----- hogs ----- sheep and goats -----

State the number of head slaughtered on a custom basis: Cattle ----- calves ----- hogs ----- sheep and goats -----

State the number of head slaughtered for you by others: Cattle ----- calves ----- hogs ----- sheep and goats -----

5. Do you manufacture or prepare livestock products for sale or shipment to points outside your State? ----- If so, indicate which of the following commodities are so handled:

Meats -----

Meat food (manufactured) products -----

Livestock (inedible) products -----

Dairy products -----

Poultry -----

Poultry products -----

Eggs -----

6. If retail markets (butcher shops) are operated in distributing products, state approximately the percentage of retail sales to total sales. -----

The following tabulation summarizes reports received from 494 packers in 1923 and from 525 in 1924:

	1923	1924
Total net worth.....	\$855, 023, 061. 72	\$889, 919, 109. 81
Total income.....	3, 109, 048, 602. 16	3, 321, 961, 071. 23
Total expenses.....	3, 038, 180, 030. 58	3, 245, 075, 724. 89
Net gain.....	70, 868, 571. 68	76, 885, 346. 34
Percentage return on net worth.....	8. 28	8. 63
Percentage return on income.....	2. 27	2. 31

The packers generally have refused the Secretary or his representatives access to their books. The books of Armour and Morris were opened to the Secretary in connection with the packer merger proceedings. About a dozen of the very small packers have permitted the auditors of the department to review their books for the purpose of studying their systems of keeping accounts.

### MANDAMUS CASES AGAINST SWIFT & CO., CUDAHY PACKING CO., AND WILSON & CO.

This department endeavored to obtain permission from the packers to examine their records as early as 1922. In December of 1922 or January of 1923 a delegation from the packers visited Secretary Wallace in his office to discuss the general subject of auditing their books. They refused to permit access to the books, so that it was necessary to institute legal proceedings.

In November, 1923, formal notices were served on Swift & Co., the Cudahy Packing Co., and Wilson & Co., demanding access to and opportunity to



examine the accounts, records, and memoranda of these packers for specified purposes. The demands were refused, and the foundation having thus been laid, mandamus proceedings were instituted by the Department of Justice at the request of the Secretary of Agriculture against the above packers in the United States District Court for the Northern District of Illinois, at Chicago.

Counsel for the packers, following the institution of the proceedings, obtained from the court an allowance of a considerable period of time for making defense to the petition for writs of mandamus and finally submitted to the court a motion to dismiss the petition on the ground that the court did not have jurisdiction to issue writs of mandamus under the packers and stockyards act.

In time the three cases were heard by the court. On June 28, 1924, Federal Judge Cliffe announced his decision to the effect that the court had jurisdiction to issue writs of mandamus in these cases, and consequently overruled the motion to dismiss the petitions of the Government. He also held that he was satisfied that on the merits of the question the Government was entitled to the issuance of writs of mandamus and directed their issuance, subject to an appeal from his action by the defendants. Subsequently the defendants were allowed to file answers to the petitions, and the three cases were set for hearing on September 26, 1924, on their merits. The cases were continued, argued, and submitted on December 8, 1924, to Judge Cliffe.

On July 25, 1925, these cases were decided in favor of the Government. Judge Cliffe did not write an opinion, but did make the following findings:

The court finds that the Secretary of Agriculture is vested with the duty of administering the statute herein.

The court further finds that the demand of the Secretary of Agriculture for access to the memoranda, records, accounts, and documents herein was within the scope of his authority as contemplated by this law.

The court further finds that compliance by the defendants with this demand of the Secretary of Agriculture in no way contravenes the constitutional rights of the defendants.

The court further finds that the demand of the Secretary of Agriculture was a reasonable one and necessary for the intelligent and effective administration of the law.

Thereafter, the cases were taken to the Circuit Court of Appeals by the packers. The packers have filed their briefs, and the reply brief of the Government is due March 25, 1926.

This department can not state when the cases will be decided by the Circuit Court of Appeals.

(C) There follows a statement relative to the volume of business done at public stockyard markets subject to the act. This is shown for all markets combined and for each market separately. There is also given a statement relative to the volume of business done by cooperative market agencies engaged in livestock commission business, showing what percentage this business is of the total business done at the markets.

The consolidated statement for all the markets show but little variation in the cattle receipts during the past four years. There has been a substantial increase each year in the calf receipts. The receipts of hogs were substantially the same in the years 1923 and 1924, being approximately 25 per cent greater than in 1922. There was a material decrease in the receipts of hogs during the year 1925, the receipts being approximately 10 per cent less than in the year 1922. The receipts of sheep were materially less in 1925 than in 1924, but the receipts for 1925 were greater than the receipts for either the year 1922 or 1923. As will appear from the table of receipts for the individual markets, the volume has increased at some and fallen off at others.

The cooperative market agencies handled 15.3 per cent of the total number of head of livestock received in 1924 at the public stockyards where such cooperative agencies are located. This percentage was 14.5 for the year 1925, showing a slight decrease. The volume handled by cooperative agencies at the various markets is shown on page 39.

#### LIVESTOCK RECEIPTS AT STOCKYARDS

[As reported by the Bureau of Agricultural Economics]

The following tabulation shows the receipts of livestock at 66 markets, covering the years 1922, 1923, 1924, and 1925:

	1922	1923	1924	1925	Total
Cattle.....	16, 753, 030	16, 975, 406	17, 158, 273	17, 101, 518	67, 988, 227
Calves.....	5, 984, 192	6, 210, 158	6, 522, 496	6, 941, 166	25, 658, 012
Hogs.....	43, 390, 760	55, 248, 675	55, 243, 203	39, 864, 399	193, 747, 037
Sheep.....	20, 402, 402	18, 605, 920	25, 847, 295	21, 985, 781	86, 841, 398
Total.....	86, 530, 384	97, 040, 159	104, 771, 267	85, 892, 864	374, 234, 674



# 32 REPORT OF THE PACKERS AND STOCKYARDS ADMINISTRATION

The above receipts include direct as well as through shipments at the various markets.

## Receipts of livestock at 66 markets

	Cattle	Calves	Hogs	Sheep	Total
<b>Arabi, La. (New Orleans Stockyards):</b>					
1922.....	81,786	110,975	40,984	4,246	237,991
1923.....	83,105	123,596	46,456	3,861	257,018
1924.....	76,994	134,812	49,602	2,299	263,707
1925.....	87,655	116,839	30,272	2,490	237,256
Total.....	329,540	486,222	167,314	12,896	995,972
<b>Albany, N. Y.:</b>					
1922.....	7,707	12,797	424	21	20,949
1923.....	6,406	7,650	440	-----	14,496
1924.....	7,847	5,334	214	-----	13,395
1925.....	6,937	3,117	61	-----	10,115
Total.....	28,897	28,898	1,139	21	58,955
<b>Amarillo, Tex.:</b>					
1922.....	140,252	128	106,261	72,871	319,512
1923.....	115,153	159	65,204	101,105	281,621
1924.....	129,926	251	20,831	159,375	310,383
1925.....	163,171	-----	20,425	148,020	331,616
Total.....	548,502	538	212,721	481,371	1,243,132
<b>Atlanta, Ga.:</b>					
1922.....	29,110	955	123,823	2,345	156,233
1923.....	55,215	3,547	200,801	4,679	264,242
1924.....	44,436	5,937	158,628	2,612	211,613
1925.....	47,965	7,243	124,416	6,247	185,871
Total.....	176,726	17,682	607,668	15,883	817,959
<b>Augusta, Ga.:</b>					
1922.....	10,121	3,680	11,399	63	25,263
1923.....	8,788	3,580	10,886	38	23,292
1924.....	6,397	2,815	7,284	149	16,645
1925.....	6,762	2,496	3,965	78	13,301
Total.....	32,068	12,571	33,534	328	78,501
<b>Baltimore, Md.:</b>					
1922.....	168,250	72,892	1,342,595	306,336	1,890,073
1923.....	161,185	67,018	1,547,235	283,967	2,059,405
1924.....	163,526	69,387	1,512,888	288,060	2,033,861
1925.....	163,167	83,431	1,006,944	306,635	1,560,177
Total.....	656,128	292,728	5,409,662	1,184,998	7,543,516
<b>Boston, Mass. (Brighton):</b>					
1922.....	44,268	32,318	8,233	1,800	86,619
1923.....	42,546	24,666	5,310	3,663	76,185
1924.....	46,716	54,025	8,194	1,503	110,438
1925.....	51,702	74,836	11,282	2,841	140,661
Total.....	185,232	185,845	33,019	9,807	413,903
<b>Buffalo, N. Y.:</b>					
1922.....	315,445	321,904	1,474,520	1,190,564	3,302,433
1923.....	297,024	291,483	1,831,063	1,226,440	3,646,010
1924.....	275,613	274,473	1,656,469	1,165,934	3,372,489
1925.....	291,289	307,899	1,130,803	1,058,708	2,788,699
Total.....	1,179,371	1,195,759	6,092,855	4,641,646	13,109,631
<b>Chattanooga, Tenn.:</b>					
1922.....	19,194	-----	13,130	3,556	35,880
1923.....	16,618	3	16,168	1,952	34,741
1924.....	15,236	-----	19,422	1,251	35,909
1925.....	14,728	-----	19,938	1,823	36,489
Total.....	65,776	3	68,658	8,582	143,019

<sup>1</sup> Calves included.

*Receipts of livestock at 66 markets—Continued*

	Cattle	Calves	Hogs	Sheep	Total
<b>Chicago, Ill.:</b>					
1922.....	3, 163, 009	771, 489	8, 156, 472	3, 023, 387	15, 114, 357
1923.....	3, 157, 100	760, 751	10, 460, 134	847, 762	15, 225, 747
1924.....	3, 202, 719	794, 350	10, 443, 175	7, 995, 964	22, 436, 208
1925.....	3, 023, 387	847, 762	4, 192, 265	3, 968, 670	12, 032, 084
Total.....	12, 546, 215	3, 174, 352	33, 252, 046	15, 835, 783	64, 808, 396
<b>Cincinnati, Ohio:</b>					
1922.....	282, 742	162, 812	1, 347, 129	394, 342	2, 187, 025
1923.....	262, 070	163, 568	1, 400, 697	345, 053	2, 171, 388
1924.....	267, 957	174, 312	1, 365, 008	327, 303	2, 134, 580
1925.....	260, 245	171, 518	1, 040, 415	369, 805	1, 841, 983
Total.....	1, 073, 014	672, 210	5, 153, 249	1, 436, 503	8, 334, 976
<b>Cleveland, Ohio:</b>					
1922.....	136, 167	145, 329	1, 092, 287	360, 432	1, 734, 215
1923.....	129, 702	148, 121	1, 185, 211	332, 714	1, 795, 748
1924.....	134, 183	150, 323	1, 269, 360	364, 822	1, 918, 688
1925.....	132, 507	160, 208	784, 720	415, 555	1, 492, 990
Total.....	532, 559	603, 981	4, 331, 578	1, 473, 523	6, 941, 641
<b>Columbia, S. C.:</b>					
1922.....	5, 797	1, 625	8, 605	396	16, 424
1923.....	7, 920	2, 505	14, 988	630	26, 043
1924.....	1, 566	618	3, 708	149	6, 041
1925.....					
Total.....	15, 283	4, 749	27, 301	1, 175	48, 508
<b>Columbus, Ohio:</b>					
1922.....	1, 670	2, 105	53, 371	2, 120	59, 266
1923.....	1, 194	1, 863	74, 119	1, 572	78, 748
1924.....	417	676	28, 855	210	30, 158
1925.....					
Total.....	3, 281	4, 644	156, 345	3, 902	168, 172
<b>Dallas, Tex.:</b>					
1922.....	6, 815	1, 440	71, 279	695	80, 229
1923.....	5, 200	1, 610	110, 553	256	117, 619
1924.....	5, 653	1, 648	107, 623	227	115, 151
1925.....	9, 924	2, 328	53, 563	204	66, 019
Total.....	27, 592	7, 026	343, 018	1, 382	379, 018
<b>Dayton, Ohio:</b>					
1922.....	23, 273	9, 340	139, 020	7, 900	179, 533
1923.....	23, 529	10, 476	167, 320	6, 890	208, 215
1924.....	23, 732	10, 597	160, 696	8, 245	203, 270
1925.....	22, 907	10, 893	122, 079	7, 745	163, 624
Total.....	93, 441	41, 306	589, 115	30, 780	754, 642
<b>Denver, Colo.:</b>					
1922.....	586, 730	69, 515	395, 219	1, 866, 784	2, 918, 248
1923.....	561, 261	58, 621	495, 292	1, 856, 578	2, 971, 752
1924.....	571, 703	58, 650	569, 038	2, 039, 660	3, 239, 051
1925.....	526, 625	60, 222	467, 404	2, 357, 010	3, 411, 261
Total.....	2, 246, 319	247, 008	1, 926, 953	8, 120, 032	12, 540, 312
<b>Detroit, Mich.:</b>					
1922.....	128, 264	124, 620	444, 961	356, 479	1, 054, 324
1923.....	132, 434	135, 822	537, 447	297, 767	1, 103, 470
1924.....	129, 230	153, 966	555, 693	393, 448	1, 232, 337
1925.....	136, 750	165, 797	438, 569	366, 505	1, 107, 621
Total.....	526, 678	580, 205	1, 976, 670	1, 414, 199	4, 497, 752
<b>East St. Louis, Ill.:</b>					
1922.....	1, 025, 763	374, 570	3, 605, 520	627, 880	5, 633, 733
1923.....	1, 040, 833	358, 076	4, 831, 181	560, 678	6, 790, 768
1924.....	1, 034, 446	350, 180	4, 579, 538	488, 630	6, 452, 794
1925.....	1, 037, 986	406, 266	3, 512, 007	558, 914	5, 515, 173
Total.....	4, 139, 028	1, 489, 092	16, 528, 246	2, 236, 102	24, 392, 468

*Receipts of livestock at 66 markets—Continued*

	Cattle	Calves	Hogs	Sheep	Total
<b>El Paso, Tex.:</b>					
1922.....	143,171	5,843	34,879	49,088	232,981
1923.....	68,974	34,378	27,238	72,832	203,422
1924.....	115,865	26,355	27,923	40,992	211,135
1925.....	123,373	53,750	25,627	123,927	326,677
Total.....	451,383	120,326	115,667	286,839	974,215
<b>Evansville, Ind.:</b>					
1922.....	28,437	16,010	235,041	10,623	290,111
1923.....	23,640	15,386	255,853	7,842	302,721
1924.....	20,805	14,830	191,202	6,326	233,163
1925.....	22,790	19,010	151,805	6,690	200,295
Total.....	95,672	65,236	833,901	31,481	1,026,290
<b>Fort Wayne, Ind.:</b>					
1922.....					
1923.....	2,569	5,174	57,995	5,528	71,266
1924.....	5,818	8,493	90,961	17,560	122,832
1925.....	6,756	11,593	94,183	20,506	133,038
Total.....	15,143	25,260	243,139	43,594	327,136
<b>Fort Worth, Tex.:</b>					
1922.....	759,927	324,274	510,342	324,870	1,919,413
1923.....	946,553	311,376	485,895	385,780	2,129,604
1924.....	1,048,966	342,559	392,414	372,515	2,156,454
1925.....	1,059,983	309,815	312,019	314,234	1,996,051
Total.....	3,815,429	1,288,024	1,700,670	1,397,399	8,201,522
<b>Fostoria, Ohio:</b>					
1922.....	8,692	6,067	104,553	14,267	133,579
1923.....	6,127	6,246	110,669	12,333	135,375
1924.....	4,866	6,680	117,472	15,393	144,411
1925.....	3,814	7,847	106,419	14,263	132,343
Total.....	23,499	26,840	439,113	56,256	545,708
<b>Indianapolis, Ind.:</b>					
1922.....	304,024	204,790	2,266,551	146,972	2,922,337
1923.....	308,097	219,758	2,875,648	123,883	3,527,386
1924.....	321,838	237,718	2,864,850	122,753	3,547,209
1925.....	298,876	248,437	2,066,703	146,682	2,760,698
Total.....	1,232,885	910,703	10,073,752	540,290	12,757,630
<b>Jacksonville, Fla.:</b>					
1922.....	4,211	587	80,752	289	85,839
1923.....	6,609	440	107,226	260	114,535
1924.....	4,521	512	85,972	269	91,274
1925.....	6,420	980	53,804	64	61,268
Total.....	21,761	2,519	327,754	882	352,916
<b>Jersey City, N. J.:</b>					
1922.....	236,380	436,502	447,298	1,467,611	2,587,791
1923.....	191,145	481,669	512,570	1,276,303	2,461,687
1924.....	220,512	490,703	534,786	1,230,246	2,476,247
1925.....	220,004	524,504	466,832	1,213,391	2,424,731
Total.....	868,041	1,933,378	1,961,486	5,187,551	9,950,456
<b>Kansas City, Mo.:</b>					
1922.....	2,443,499	539,595	2,654,959	1,574,217	7,212,270
1923.....	2,631,808	576,122	3,615,205	1,671,145	8,494,280
1924.....	2,471,291	571,517	2,932,941	1,569,070	7,544,819
1925.....	2,409,012	549,420	2,067,038	1,499,730	6,525,200
Total.....	9,955,610	2,236,654	11,270,143	6,314,162	29,776,569
<b>Knoxville, Tenn.:</b>					
1922.....	22,208	1,417	57,372	2,076	83,073
1923.....	20,231	1,541	43,861	1,362	66,995
1924.....	23,233	1,415	52,135	1,697	78,480
1925.....	25,262	1,357	38,506	2,670	67,795
Total.....	90,934	5,730	191,874	7,805	296,343



*Receipts of livestock at 66 markets—Continued*

	Cattle	Calves	Hogs	Sheep	Total
<b>La Fayette, Ind.:</b>					
1922.....	6,781	6,263	104,926	4,336	122,306
1923.....	6,416	6,298	129,083	4,237	146,034
1924.....	7,149	7,295	142,191	5,661	162,296
1925.....	7,672	8,200	121,666	6,323	143,861
Total.....	28,018	28,056	497,866	20,557	574,497
<b>Lancaster, Pa.:</b>					
1922.....	216,800	17,120	76,118	27,247	337,285
1923.....	198,008	30,710	155,382	52,682	436,782
1924.....	200,994	22,075	80,545	14,640	318,254
1925.....	211,272	21,793	65,968	18,103	317,136
Total.....	827,074	91,698	378,013	112,672	1,409,457
<b>Laredo, Tex.:</b>					
1923.....	13,479	1,066	2,070	1,138	17,753
1924.....	8,349	3,352	3,178	3,423	18,302
1925.....	13,244	2,463	2,634	3,045	21,386
Total.....	35,072	6,881	7,882	7,606	57,441
<b>Los Angeles, Calif.:</b>					
1923.....	135,118	47,752	227,434	75,342	485,646
1924.....	165,218	87,022	269,747	102,105	624,092
1925.....	169,533	77,302	217,404	29,693	493,932
Total.....	469,869	212,076	714,585	207,140	1,603,670
<b>Louisville, Ky.:</b>					
1922.....	168,309	114,627	497,055	318,325	1,098,316
1923.....	146,124	109,432	625,646	264,837	1,146,039
1924.....	131,999	98,798	470,425	213,348	914,570
1925.....	136,842	103,452	295,379	229,493	765,166
Total.....	583,274	426,309	1,888,505	1,026,003	3,924,091
<b>Marion, Ohio:</b>					
1922.....	8,748	6,944	109,124	13,104	137,920
1923.....	4,184	5,131	102,632	10,928	122,875
1924.....	2,585	3,883	82,308	11,878	100,654
1925.....	2,044	3,375	54,331	8,236	67,986
Total.....	17,561	19,333	348,395	44,146	429,435
<b>Memphis, Tenn.:</b>					
1922.....	9,428	3,212	9,645	810	23,095
1923.....	19,922	2,095	84,680	1,951	108,648
1924.....	15,434	3,655	80,784	1,441	101,314
1925.....	19,184	5,174	65,571	4,347	94,276
Total.....	63,968	14,136	240,680	8,549	327,333
<b>Milwaukee, Wis.:</b>					
1922.....	118,002	386,322	466,082	44,520	1,014,926
1923.....	111,874	400,567	555,268	39,932	1,107,641
1924.....	106,904	425,313	522,982	36,968	1,092,167
1925.....	126,592	461,248	458,545	44,878	1,091,263
Total.....	463,372	1,673,450	2,002,877	166,298	4,305,997
<b>Montgomery, Ala.:</b>					
1922.....	56,442	504	94,428	2,280	153,654
1923.....	68,099	6,675	72,776	2,806	150,356
1924.....	64,475	12,547	61,959	1,665	140,646
1925.....	58,179	14,864	46,798	2,952	122,793
Total.....	247,195	34,590	275,961	9,703	567,449
<b>Moultrie, Ga.:</b>					
1922.....	3,306	1,511	51,993		56,810
1923.....	4,207	635	33,366	1	38,209
1924.....	6,198	384	29,600	363	36,545
1925.....	5,844		37,999	62	43,905
Total.....	19,555	2,530	152,958	426	175,469
<b>Muncie, Ind.: <sup>2</sup></b>					
1925.....	527	711	9,689	921	11,848
Total.....	527	711	9,689	921	11,848

<sup>2</sup> Registered Mar. 5, 1924.

*Receipts of livestock at 66 markets—Continued*

	Cattle	Calves	Hogs	Sheep	Total
Nashville, Tenn.:					
1922.....	73, 416	35, 373	517, 007	152, 196	777, 992
1923.....	63, 678	32, 000	492, 130	129, 453	717, 261
1924.....	64, 174	35, 704	312, 118	116, 376	528, 372
1925.....	65, 894	50, 304	242, 834	145, 398	504, 430
Total.....	267, 162	153, 381	1, 564, 089	543, 423	2, 528, 055
Newark, N. J.:					
1923.....	23, 803	17, 666	575, 686	28, 840	645, 995
1924.....	23, 859	22, 047	605, 229	32, 623	683, 758
1925.....	22, 356	19, 075	533, 469	37, 993	612, 893
Total.....	70, 018	58, 788	1, 714, 384	99, 456	1, 942, 646
New York, N. Y.:					
1922.....	70, 037	187, 753	1, 091, 099	143, 334	1, 492, 223
1923.....	70, 717	145, 243	1, 159, 888	74, 549	1, 450, 402
1924.....	60, 029	157, 503	1, 198, 723	67, 783	1, 484, 038
1925.....	64, 566	157, 332	928, 139	108, 959	1, 258, 996
Total.....	265, 349	647, 836	4, 377, 849	394, 625	5, 685, 659
North Salt Lake, Utah:					
1922.....	86, 011	2, 310	84, 035	459, 453	631, 809
1923.....	71, 486	2, 082	234, 019	449, 006	756, 593
1924.....	93, 062	5, 713	474, 707	617, 784	1, 191, 266
1925.....	95, 526	4, 743	379, 774	687, 955	1, 167, 998
Total.....	346, 085	14, 848	1, 172, 535	2, 214, 198	3, 747, 666
Ogden, Utah:					
1922.....	87, 350	3, 857	198, 292	704, 419	993, 918
1923.....	117, 393	4, 530	256, 413	849, 101	1, 227, 437
1924.....	146, 204	8, 873	280, 338	564, 694	1, 000, 109
1925.....	155, 514	7, 490	255, 168	884, 237	1, 302, 409
Total.....	506, 461	24, 750	990, 211	3, 002, 451	4, 523, 873
Oklahoma City, Okla.:					
1922.....	331, 758	50, 583	504, 378	17, 888	904, 607
1923.....	337, 927	76, 609	487, 856	9, 280	911, 672
1924.....	287, 275	101, 164	324, 607	9, 218	722, 264
1925.....	300, 464	103, 652	275, 526	10, 130	689, 772
Total.....	1, 257, 424	332, 008	1, 592, 367	46, 516	3, 228, 315
Omaha, Nebr.:					
1922.....	1, 612, 143	132, 108	2, 859, 382	2, 532, 787	7, 116, 420
1923.....	1, 684, 665	108, 267	3, 649, 496	2, 969, 652	8, 412, 080
1924.....	1, 758, 924	103, 622	3, 978, 288	2, 844, 421	8, 685, 255
1925.....	1, 592, 599	116, 221	3, 355, 207	2, 419, 551	7, 483, 578
Total.....	6, 648, 331	460, 218	13, 822, 373	10, 766, 411	31, 697, 333
Pasco, Wash.:					
1922.....	6, 078	298	1, 164	65, 678	73, 218
1923.....	2, 368	23	1, 826	65, 966	70, 183
1924.....	5, 285	233	8, 957	83, 429	97, 904
1925.....	6, 599	161	8, 974	71, 658	87, 392
Total.....	20, 330	715	20, 921	286, 731	328, 697
Peoria, Ill.:					
1922.....	24, 284	15, 379	385, 451	2, 651	427, 765
1923.....	19, 427	18, 461	572, 948	3, 805	614, 641
1924.....	24, 940	20, 611	880, 241	3, 452	929, 244
1925.....	26, 860	29, 289	705, 697	5, 729	767, 575
Total.....	95, 511	83, 740	2, 544, 337	15, 637	2, 739, 225
Philadelphia, Pa.:					
1922.....	91, 161	109, 403	313, 764	260, 565	774, 893
1923.....	78, 553	100, 113	357, 634	248, 102	784, 402
1924.....	78, 191	113, 518	375, 006	251, 102	817, 817
1925.....	70, 228	117, 757	277, 617	227, 105	692, 707
Total.....	318, 133	440, 791	1, 324, 021	986, 874	3, 069, 819

*Receipts of livestock at 66 markets—Continued*

	Cattle	Calves	Hogs	Sheep	Total
<b>Pittsburgh, Pa.:</b>					
1922.....	532, 198	334, 566	2, 690, 137	1, 204, 217	4, 761, 118
1923.....	414, 896	405, 896	3, 053, 870	1, 045, 009	4, 919, 671
1924.....	490, 642	418, 438	3, 038, 255	978, 523	4, 925, 858
1925.....	464, 057	423, 369	2, 311, 575	909, 677	4, 108, 678
Total.....	1, 901, 793	1, 582, 269	11, 093, 837	4, 137, 426	18, 715, 325
<b>Portland, Oreg.:</b>					
1922.....	126, 953	12, 718	224, 310	205, 106	569, 087
1923.....	146, 077	22, 246	286, 465	179, 480	634, 268
1924.....	145, 567	29, 868	356, 601	199, 346	731, 382
1925.....	148, 413	27, 348	265, 495	178, 581	619, 837
Total.....	567, 010	92, 180	1, 132, 871	762, 513	2, 554, 574
<b>Pueblo, Colo.:</b>					
1922.....	198, 906	493	10, 638	644, 838	854, 875
1923.....	147, 262	4, 119	15, 628	703, 911	870, 920
1924.....	105, 001	3, 462	37, 699	874, 806	1, 020, 968
1925.....	107, 840	4, 263	28, 633	713, 149	853, 885
Total.....	559, 009	12, 337	92, 598	2, 936, 704	3, 600, 648
<b>Richmond, Va.:</b>					
1922.....	23, 173	8, 648	219, 155	11, 580	262, 556
1923.....	24, 440	8, 050	272, 980	9, 026	314, 496
1924.....	23, 235	9, 554	329, 090	8, 950	370, 829
1925.....	27, 783	10, 799	197, 331	8, 203	244, 116
Total.....	98, 631	37, 051	1, 018, 556	37, 759	1, 191, 997
<b>Roanoke, Va.:</b>					
1923.....	1, 469	83	8, 534	4, 160	14, 246
1924.....	611	120	9, 864	89	10, 684
Total.....	2, 080	203	18, 398	4, 249	24, 930
<b>St. Joseph, Mo.:</b>					
1922.....	554, 095	100, 457	2, 060, 680	729, 784	3, 445, 016
1923.....	607, 829	100, 730	2, 456, 962	979, 488	4, 145, 009
1924.....	602, 349	117, 433	2, 234, 366	1, 088, 731	4, 042, 929
1925.....	608, 616	125, 132	1, 672, 530	1, 142, 857	3, 549, 135
Total.....	2, 372, 889	443, 802	8, 424, 538	3, 940, 860	15, 182, 089
<b>South St. Paul, Minn.:</b>					
1922.....	929, 847	457, 085	2, 522, 972	498, 891	4, 408, 795
1923.....	839, 032	508, 804	3, 338, 413	453, 917	5, 140, 166
1924.....	789, 526	533, 860	3, 751, 395	475, 821	5, 550, 602
1925.....	994, 905	641, 281	3, 636, 934	545, 296	5, 818, 416
Total.....	3, 553, 310	2, 141, 030	13, 249, 714	1, 973, 925	20, 917, 979
<b>San Antonio, Tex.:</b>					
1922.....	125, 504	72, 496	63, 118	66, 127	327, 245
1923.....	95, 013	67, 850	61, 122	22, 599	246, 584
1924.....	107, 631	74, 857	63, 789	18, 302	264, 879
1925.....	93, 003	73, 496	55, 951	10, 735	233, 185
Total.....	421, 451	288, 699	243, 980	117, 763	1, 071, 893
<b>Seattle, Wash.:</b>					
1922.....	44, 323	2, 165	151, 351	69, 581	267, 420
1923.....	51, 920	3, 575	218, 038	85, 757	359, 290
1924.....	58, 336	5, 203	274, 639	99, 745	437, 923
1925.....	50, 795	6, 206	255, 840	77, 944	390, 785
Total.....	205, 374	17, 149	899, 868	333, 027	1, 455, 418
<b>Sioux City, Iowa:</b>					
1922.....	690, 942	56, 041	1, 855, 829	222, 748	2, 825, 560
1923.....	714, 008	45, 486	2, 988, 895	215, 604	3, 963, 993
1924.....	797, 935	37, 806	3, 732, 178	309, 584	4, 877, 503
1925.....	844, 797	51, 964	3, 395, 934	359, 830	4, 652, 525
Total.....	3, 047, 682	191, 297	11, 972, 836	1, 107, 766	16, 319, 581



*Receipts of livestock at 66 markets—Continued*

	Cattle	Calves	Hogs	Sheep	Total
Sioux Falls, S. Dak.:					
1922.....	30, 279	2, 705	532, 675	1, 660	567, 319
1923.....	25, 631	4, 832	503, 108	5, 197	538, 768
1924.....	12, 084	1, 812	121, 990	4, 862	140, 748
1925.....	21, 220	3, 268	191, 532	2, 652	218, 672
Total.....	89, 214	12, 617	1, 349, 305	14, 371	1, 465, 507
Spokane, Wash.:					
1922.....	44, 296	4, 323	47, 588	63, 010	159, 217
1923.....	40, 047	4, 536	82, 120	27, 820	154, 523
1924.....	48, 125	6, 603	132, 990	48, 016	235, 734
1925.....	53, 496	6, 659	166, 528	37, 014	263, 697
Total.....	185, 964	22, 121	429, 226	175, 860	813, 171
Springfield, Ohio:					
1922.....					
1923.....	4, 256	2, 793	63, 925	9, 325	80, 299
1924.....	4, 402	4, 786	91, 211	13, 970	114, 369
1925.....	5, 119	7, 957	108, 922	15, 823	137, 821
Total.....	13, 777	15, 536	264, 058	39, 118	332, 489
Toledo, Ohio:					
1922.....	16, 428	8, 759	140, 175	20, 050	185, 412
1923.....	17, 430	7, 744	158, 049	13, 173	196, 396
1924.....	18, 538	6, 904	154, 176	27, 729	207, 347
1925.....	16, 881	7, 090	126, 155	20, 304	170, 430
Total.....	69, 277	30, 497	578, 555	81, 256	759, 585
Washington, D. C. (Benning Stockyards):					
1922.....	15, 866	12, 663	131, 523	20, 511	180, 563
1923.....	16, 612	15, 267	165, 616	17, 183	214, 678
1924.....	16, 659	16, 330	192, 604	15, 934	241, 527
1925.....	19, 232	17, 170	139, 780	14, 288	190, 470
Total.....	68, 369	61, 430	629, 523	67, 916	827, 238
Wichita, Kans.:					
1922.....	323, 254	83, 926	569, 687	82, 476	1, 059, 343
1923.....	339, 000	77, 582	706, 052	119, 790	1, 242, 424
1924.....	310, 022	78, 962	733, 541	83, 851	1, 206, 376
1925.....	333, 825	82, 990	630, 806	89, 253	1, 136, 874
Total.....	1, 306, 101	323, 460	2, 640, 086	375, 370	4, 645, 017

NOTE.—The following markets are within the jurisdiction of the Packers and Stockyards Administration, but no figures are given in Crops and Markets: Galesburg, Ill., horse and mule market, posted April, 1925; Muncie, Ind., posted March, 1925; San Francisco, Calif., posted December 3, 1923; Springfield, Ill., posted February 11, 1926; Springfield, Mo., posted December 3, 1925.

*Receipts of livestock, by cooperative agencies, and comparison with total receipts at markets where cooperatives are located*

1924

Terminal markets	Cattle and calves	Hogs	Sheep	Total head, cooperatives	Percentage of cooperatives to total	Total market receipts <sup>1</sup>
Buffalo, N. Y.	57,262	390,242	153,094	600,598	0.178	3,372,489
Chicago, Ill.	172,110	1,329,995	252,557	1,754,662	.094	18,632,509
Cleveland, Ohio	53,851	329,584	80,727	464,162	.241	1,918,688
Denver, Colo.	11,383	113,925	110,221	235,529	.072	3,239,051
Detroit, Mich.	100,117	222,606	97,077	419,800	.340	1,252,337
Evansville, Ind.	10,819	79,050	2,522	92,391	.396	233,163
Fort Worth, Tex.	145,436	10,773	18,099	174,308	.080	2,156,454
Indianapolis, Ind.	102,946	771,276	24,973	899,195	.253	3,547,209
Kansas City, Mo.	222,102	452,868	88,732	763,702	.101	7,544,819
Milwaukee, Wis.	86,104	77,656	3,107	166,867	.152	1,092,167
National Stockyards, Ill.	308,741	1,714,001	144,534	2,167,276	.335	6,452,794
Oklahoma City, Okla.	10,900	15,798	186	26,884	.037	722,264
Omaha, Nebr.	72,769	605,102	70,291	748,162	.086	8,685,255
Peoria, Ill.	9,419	177,924	541	187,884	.202	929,244
Pittsburgh, Pa.	26,965	222,277	57,748	306,990	.062	4,925,858
St. Joseph, Mo.	76,311	667,026	37,063	780,400	.193	4,042,929
St. Paul, Minn.	355,372	1,375,377	75,386	1,806,135	.325	5,550,602
Sioux City, Iowa	66,474	635,509	14,845	716,828	.146	4,877,503
Wichita, Kans.	30,156	28,083	823	59,062	.048	1,206,376
Total	1,919,237	9,219,072	1,232,526	12,370,835	.153	80,361,711

1925

Buffalo, N. Y.	57,732	283,327	144,175	485,234	0.174	2,788,699
Chicago, Ill.	154,085	1,054,834	316,644	1,525,563	.096	15,835,783
Cincinnati, Ohio	26,086	122,066	17,519	165,671	.089	1,841,983
Cleveland, Ohio	50,580	200,780	87,311	338,671	.226	1,492,990
Denver, Colo.	10,146	75,042	219,681	304,869	.089	3,411,261
Detroit, Mich.	91,089	149,108	96,822	337,019	.304	1,107,621
Evansville, Ind.	18,543	69,564	3,118	91,225	.455	200,295
Fort Worth, Tex.	131,214	8,723	9,515	149,452	.074	1,996,051
Indianapolis, Ind.	107,339	573,600	25,806	706,745	.256	2,760,698
Kansas City, Mo.	150,756	295,002	54,413	500,171	.076	6,525,200
Milwaukee, Wis.	90,443	61,609	3,371	155,423	.142	1,091,263
National Stockyards, Ill.	302,283	1,277,585	142,217	1,722,085	.312	5,515,173
Oklahoma City, Okla.	3,845	8,513	276	12,634	.018	689,772
Omaha, Nebr.	69,060	479,944	47,956	596,960	.079	7,483,578
Peoria, Ill.	10,853	170,672	682	182,207	.237	767,575
Pittsburgh, Pa.	27,270	128,228	52,645	208,143	.050	4,108,678
St. Joseph, Mo.	8,859	461,012	33,846	503,717	.141	3,549,135
St. Paul, Minn.	422,539	1,307,576	93,067	1,823,182	.313	5,818,416
Sioux City, Iowa	74,146	642,704	14,181	731,031	.157	4,652,525
Sioux Falls, S. Dak.	32	2,311	13	2,356	.010	218,672
Wichita, Kans.	28,668	25,423	2,677	56,768	.049	1,136,874
Total	1,835,568	7,397,623	1,365,935	10,599,126	.145	72,992,242

<sup>1</sup> Total market receipts include direct receipts to packers where same are handled through the stockyards.

(D) Heretofore in this report in connection with the subject of rates and charges (page 8), reference has been made to the investigation of tariffs and the increases and decreases in rates which have taken place. With the exception of the frequent changes in feed prices due to the fluctuations of market prices, there has been very little change in rates and charges. There has been a tendency to increase the charges at some markets on livestock that is hauled or driven in. Recently, certain of the market agencies, not including the cooperative and several independent organizations, at

Omaha and Sioux City have filed schedules increasing their rates materially. These schedules have been suspended pending investigation and hearings have been ordered.

The formal proceedings involving rates and charges are set out in detail in the formal docket list, beginning at page 11. The docket list shows the cases pending and those terminated, and the reasons therefor. Since the last annual report 7 rate cases were dismissed and 13 are pending.

In addition to the formal proceedings involving investigation of the reasonableness of rates and charges, extensive

preliminary investigations are made when schedules are filed increasing rates. Such investigations include the study of the financial status of the operations of the stockyard owner or market agency which filed the schedule. Special reports are often required showing facts bearing on the proposed increase. In some cases it is necessary for the administration to make a special audit of the business of the company or firm in question in order to get the required information. As a result of such preliminary in-

vestigation it frequently happens that proposed increases are withdrawn or modified voluntarily by the stockyard company or market agency. A number of schedules proposing increases were withdrawn or modified during the period covered by this report.

There follows a statement showing the rates and charges for yardage and feed at 25 yards and the changes made in such charges since July 1, 1924. There is also given a statement of the rates and charges at those yards for selling straight carloads of livestock.

*Rates and charges for yardage and feed at 25 stockyards and changes made in such charges since July 1, 1924.*

UNION STOCK YARD COMPANY, BALTIMORE, MD.

Date	Yardage per head				Feed			
	Cattle	Calves	Hogs	Sheep	Hay, per 100 pounds	Corn, per bushel	Cracked corn (Chop), per bushel	Oats, per bushel
1924								
July 1.....	<sup>1</sup> \$0.40	<sup>2</sup> \$0.20	<sup>3</sup> \$0.10	<sup>4</sup> \$0.08	\$2.25	\$1.65	\$1.65	\$1.00
July 28.....	1.40	2.20	3.10	4.08	2.25	1.80	1.80	1.00
Aug. 30.....	1.40	2.20	3.10	4.08	2.25	1.90	1.90	1.00
Sept. 19.....	1.40	2.20	3.10	4.08	2.00	1.90	1.90	1.00
Dec. 26.....	1.40	2.20	3.10	4.08	2.00	2.00	2.00	1.00
1925								
Oct. 23.....	1.40	2.20	3.10	4.08	2.00	1.75	1.75	1.00

<sup>1</sup> Maximum, \$12 per car.

<sup>2</sup> Maximum, \$20 per car.

<sup>3</sup> Maximum, \$18 per car.

<sup>4</sup> Maximum, \$20 per car.

THE BUFFALO STOCK YARDS, BUFFALO, N. Y.

Date	Yardage per head								Feed		
	Cattle		Calves		Hogs		Sheep		Hay, per cwt.	Corn, per bushel	Oats, per bushel
	A	B	A	B	A	B	A	B			
1924											
July 1.....	\$0.30	\$0.50	\$0.25	\$0.35	\$0.12	\$0.22	\$0.08	\$0.14	\$1.90	\$1.40	\$1.25
24.....	.30	.50	.25	.35	.12	.22	.08	.14	1.90	1.50	1.25
Aug. 7.....	.30	.50	.25	.35	.12	.22	.08	.14	1.90	1.60	1.25
12.....	.30	.50	.25	.35	.12	.22	.08	.14	1.90	1.70	1.25
Dec. 11.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.70	1.25
20.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.80	1.25
1925											
Oct. 1.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.70	1.25
22.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.60	1.25
Dec. 24.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.50	1.25
1926											
Jan. 21.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.40	1.25

NOTE.—A, when fed in stockyards; B, when not fed in stockyards.



Rates and charges for yardage and feed at 25 stockyards and changes made in such charges since July 1, 1924—Continued

## UNION STOCKYARD &amp; TRANSIT CO. OF CHICAGO, CHICAGO, ILL.

Date	Yardage per head				Feed			
	Cattle	Calves <sup>1</sup>	Hogs	Sheep	Corn per bushel	Tame hay per cwt.	Prairie hay per cwt.	Oats per bushel
1924								
July 1.....	\$0.35	\$0.25	\$0.12	\$0.08	\$1.35	\$1.80	\$1.60	\$1.00
July 8.....	.35	.25	.12	.08	1.45	1.80	1.60	1.00
July 19.....	.35	.25	.12	.08	1.55	1.80	1.60	1.00
July 25.....	.35	.25	.12	.08	1.65	1.80	1.60	1.00
Aug. 16.....	.35	.25	.12	.08	1.65	1.70	1.60	1.00
Aug. 29.....	.35	.25	.12	.08	1.75	1.70	1.60	1.00
1925								
Jan. 17.....	.35	.25	.12	.08	1.75	1.60	1.60	1.00
Apr. 20.....	.35	.25	.12	.08	1.65	1.60	1.60	1.00
June 24.....	.35	.25	.12	.08	1.65	1.70	1.60	1.00
Aug. 17.....	.35	.25	.12	.08	1.65	1.80	1.60	1.00
Oct. 1.....	.35	.25	.12	.08	1.55	1.90	1.60	1.00
Oct. 14.....	.35	.25	.12	.08	1.45	1.90	1.60	1.00
1926								
Mar. 1.....	.35	.25	.12	.08	1.35	1.90	1.60	1.00

## CINCINNATI UNION STOCKYARDS CO., CINCINNATI, OHIO

Date	Yardage per head								Feed		
	Cattle		Calves		Hogs		Sheep		Corn per bushel	Hay per cwt.	Oats per bushel
	R. R.	Hauled in	R. R.	Hauled in	R. R.	Hauled in	R. R.	Hauled in			
1924											
July 1.....	\$0.30	\$0.35	\$0.15	\$0.20	\$0.10	\$0.12	\$0.08	\$0.10	\$1.40	\$1.90	\$1.00
July 9.....	.30	.35	.15	.20	.10	.12	.08	.10	1.50	1.90	1.00
Aug. 1.....	.30	.35	.15	.20	.10	.12	.08	.10	1.75	1.75	1.00
Oct. 25.....	.30	.35	.15	.20	.10	.12	.08	.10	1.75	1.65	1.00
Nov. 22.....	.30	.35	.15	.20	.10	.12	.08	.10	1.60	1.60	1.00
Dec. 27.....	.30	.35	.15	.20	.10	.12	.08	.10	1.75	1.60	1.00
1925											
Jan. 25.....	.30	.35	.15	.20	.10	.12	.08	.10	1.85	1.60	1.00
July 9.....	.30	.35	.15	.20	.10	.12	.08	.10	1.70	1.60	1.00
Aug. 29.....	.30	.35	.15	.20	.10	.12	.08	.10	1.70	1.75	1.00
Oct. 17.....	.30	.35	.15	.20	.10	.12	.08	.10	1.50	1.90	1.00
Dec. 19.....	.30	.35	.15	.20	.10	.12	.08	.10	1.30	1.90	1.00

## CLEVELAND UNION STOCK YARDS CO., CLEVELAND, OHIO

Date	Yardage per head								Feed	
	Cattle		Calves		Hogs		Sheep		Corn per bushel	Tame hay per cwt.
	R. R.	Hauled in	R. R.	Hauled in	R. R.	Hauled in	R. R.	Hauled in		
1924										
July 1.....	\$0.33	\$0.40	\$0.25	\$0.30	\$0.12	\$0.16	\$0.08	\$0.12	\$1.50	\$1.75
Aug. 25.....	.33	.40	.25	.30	.12	.16	.08	.12	1.65	1.75
Dec. 21.....	.33	.40	.25	.30	.12	.16	.08	.12	1.90	1.60
1925										
Sept. 1.....	.33	.40	.35	.30	.12	.16	.08	.12	1.90	1.75
15.....	.33	.40	.25	.30	.12	.16	.08	.12	1.60	1.75
Dec. 20.....	.33	.40	.25	.30	.12	.16	.08	.12	1.40	1.75

<sup>1</sup> Bushel, by weight.

# 42 REPORT OF THE PACKERS AND STOCKYARDS ADMINISTRATION

Rates and charges for yardage and feed at 25 stockyards and changes made in such charges since July 1, 1924—Continued

## DENVER UNION STOCK YARDS CO., DENVER, COLO.

Date	Yardage per head				Feed				
	Cattle	Calves	Hogs	Sheep	Prairie hay on fence per ton	Prairie hay fed per ton	Alfalfa hay on fence per ton	Alfalfa hay fed per ton	Corn per bushel
1924									
July 1.....	\$0.35	\$0.25	\$0.12	\$0.08	\$26.00	\$28.00	\$30.00	\$32.00	\$1.40
10.....	.35	.25	.12	.08	28.00	30.00	30.00	32.00	1.40
Aug. 10.....	.35	.25	.12	.08	28.00	30.00	30.00	32.00	1.60
Nov. 1.....	.35	.25	.12	.08	26.00	28.00	30.00	32.00	1.60
1925									
Jan. 26.....	.35	.25	.12	.08	26.00	28.00	30.00	32.00	1.80
May 15.....	.35	.25	.12	.08	26.00	28.00	30.00	32.00	1.65
Sept. 10.....	.35	.25	.12	.08	26.00	28.00	33.00	35.00	1.65
Nov. 21.....	.35	.25	.12	.08	cwt. 1.40	cwt. 1.50	33.00	35.00	1.50

## THE DETROIT STOCK YARDS, DETROIT, MICH.

Date	Yardage, per head								Feed		
	Cattle		Calves		Hogs		Sheep		Hay, per cwt.	Corn, per bushel	Oats, per bushel
	A	B	A	B	A	B	A	B			
1924											
July 1.....	\$0.30	\$0.50	\$0.25	\$0.35	\$0.12	\$0.22	\$0.08	\$0.14	\$1.90	\$1.40	\$1.25
24.....	.30	.50	.25	.35	.12	.22	.08	.14	1.90	1.50	1.25
Aug. 7.....	.30	.50	.25	.35	.12	.22	.08	.14	1.90	1.60	1.25
12.....	.30	.50	.25	.35	.12	.22	.08	.14	1.90	1.70	1.25
Dec. 11.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.70	1.25
20.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.80	1.25
1925											
Oct. 1.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.70	1.25
22.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.60	1.25
Dec. 24.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.50	1.25
1926											
Jan. 21.....	.30	.50	.25	.35	.12	.22	.08	.14	1.80	1.40	1.25

NOTE.—A, when fed in yards; B, when not fed in yards.

## FORT WORTH STOCK YARDS CO., FORT WORTH, TEX.

Date	Yardage, per head				Feed			
	Cattle	Calves	Hogs	Sheep	Prairie hay, per cwt.	Alfalfa per cwt.	Corn, per bushel	Oats, per bushel
1924								
July 1.....	<sup>1</sup> \$0.35	<sup>2</sup> \$0.25	<sup>3</sup> \$0.12	<sup>3</sup> \$0.08	\$1.50	\$1.90	\$1.50	\$1.00
Aug. 25.....	.35	.25	.12	.08	1.50	1.90	1.65	1.00

<sup>1</sup> Maximum \$13.50 per car.

<sup>2</sup> Maximum \$13.50 per deck.

<sup>3</sup> Maximum \$15.00 per deck.

*Rates and charges for yardage and feed at 25 stockyards and changes made in such charges since July 1, 1924—Continued*

## BELT RAILROAD &amp; STOCK YARDS CO., INDIANAPOLIS, IND.

Date	Yardage per head								Feed		
	Cattle		Calves		Hogs		Sheep		Hay, timothy per hundred weight	Corn per bushel	Oats per bushel
	A	B	A	B	A	B	A	B			
1924											
July 1.....	\$0.30	\$0.35	\$0.15	\$0.17	\$0.10	\$0.12	\$0.06	\$0.08	\$1.80	\$1.35	\$1.00
18.....	.30	.35	.15	.17	.10	.12	.06	.08	1.80	1.40	1.00
22.....	.30	.35	.15	.17	.10	.12	.06	.08	1.70	1.60	1.00
Oct. 17.....	.30	.35	.15	.17	.10	.12	.06	.08	1.50	1.60	1.00
1925											
Jan. 6.....	.30	.35	.15	.17	.10	.12	.06	.08	1.50	1.80	1.00
Apr. 15.....	.30	.35	.15	.17	.10	.12	.06	.08	1.50	1.70	1.00
Aug. 27.....	.30	.35	.15	.17	.10	.12	.06	.08	1.70	1.70	1.00
Oct. 15.....	.30	.35	.15	.17	.10	.12	.06	.08	1.70	1.60	1.00
Nov. 12.....	.30	.35	.15	.17	.10	.12	.06	.08	1.70	1.50	1.00
1926											
Jan. 1.....	.30	.35	.15	.17	.10	.12	.06	.08	1.90	1.30	1.00

NOTE.—A, via railroad or interurban; B, driven or hauled in.

## THE JERSEY CITY STOCK YARDS CO., JERSEY CITY, N. J.

Date	Yardage, per head								Feed		
	Cattle		Calves		Hogs		Sheep		Hay, per cwt.	Corn, per bushel	Oats, per bushel
	A	B	A	B	A	B	A	B			
1924											
July 1.....	\$0.40	\$0.50	\$0.20	\$0.25	\$0.12	\$0.15	\$0.08	\$0.10	\$2.25	\$1.65	\$1.25
July 29.....	.40	.50	.20	.25	.12	.15	.08	.10	2.25	1.80	1.40
Aug. 29.....	.40	.50	.20	.25	.12	.15	.08	.10	2.25	1.90	1.40
Sept. 20.....	.40	.50	.20	.25	.12	.15	.08	.10	2.00	1.90	1.40
1925											
Jan. 1.....	.40	.50	.20	.25	.12	.15	.08	.10	2.00	2.00	2.40
Oct. 10.....	.40	.50	.20	.25	.12	.15	.08	.10	2.00	1.75	1.40

NOTE.—A, arriving in carload lots via railroad; B, driven or trucked-in or arrives by railroad in less than carload lots.

## KANSAS CITY STOCK YARDS CO., KANSAS CITY, MO.

Date	Yardage, per head				Feed			
	Cattle	Calves	Hogs	Sheep	Corn, per bushel	Prairie hay, per hundred- weight	Alfalfa, per hundred- weight	Oats, per bushel
1924								
July 1.....	\$0.35	\$0.25	\$0.12	\$0.08	\$1.20	\$1.25	\$1.75	\$0.75
July 14.....	.35	.25	.12	.08	1.35	1.25	1.75	.75
July 29.....	.35	.25	.12	.08	1.50	1.25	1.75	.95
1925								
Jan. 3.....	.35	.25	.12	.08	1.65	1.125	1.75	.95
Apr. 21.....	.35	.25	.12	.08	1.50	1.125	1.50	.95
Oct. 4.....	.35	.25	.12	.08	1.50	1.25	1.50	.95
Nov. 5.....	.35	.25	.12	.08	1.40	1.25	1.625	.95
Dec. 11.....	.35	.25	.12	.08	1.30	1.25	1.625	.95



# 44 REPORT OF THE PACKERS AND STOCKYARDS ADMINISTRATION

*Rates and charges for yardage and feed at 25 stockyards and changes made in such charges since July 1, 1924—Continued*

## LOS ANGELES UNION STOCK YARDS CO., LOS ANGELES, CALIF.

Date	Yardage, per head				Feed			
	Cattle	Calves	Hogs	Sheep	Alfalfa hay, per hundred-weight	Barley hay, per hundred-weight	Corn, per bushel	Barley (grain), per bushel
1924								
July 1.....	\$0.35	\$0.25	\$0.12	\$0.08	\$2.00	\$1.75	\$1.80	\$1.40
Oct. 15.....	.35	.25	.12	.08	2.00	1.75	2.00	1.60
1925								
Aug. 1.....	.35	.25	.12	.08	1.80	1.75	1.80	1.40

## BOURBON STOCK YARD CO., LOUISVILLE, KY.

Date	Yardage, per head								Feed				
	Cattle		Calves		Hogs		Sheep		Clover hay per 100 lbs.	Timothy hay per 100 lbs.	Alfalfa hay per 100 lbs.	Corn per bushel	Oats per bushel
	A	B	A	B	A	B	A	B					
1924													
July 1.....	\$0.30	\$0.35	\$0.15	\$0.20	\$0.10	\$0.12	\$0.08	\$0.10	\$1.85	\$1.85	\$1.85	\$1.50	\$1.00
July 6.....	.30	.35	.15	.20	.10	.12	.08	.10	1.90	1.90	1.90	1.50	1.00
July 13.....	.30	.35	.15	.20	.10	.12	.08	.10	1.90	1.90	1.90	1.60	1.00
Aug. 6.....	.30	.35	.15	.20	.10	.12	.08	.10	1.90	1.90	1.90	1.80	1.00
Sept. 1.....	.30	.35	.15	.20	.10	.12	.08	.10	1.80	1.80	1.90	1.80	1.00
Nov. 11.....	.30	.35	.15	.20	.10	.12	.08	.10	1.80	1.75	1.90	1.80	1.00
1925													
Jan. 28.....	.30	.35	.15	.20	.10	.12	.08	.10	1.80	1.75	1.90	1.90	1.00
Apr. 1.....	.35	.40	.16	.20	.11	.13	.09	.11	1.80	1.75	1.90	1.90	1.00
Apr. 20.....	.35	.40	.16	.20	.11	.13	.09	.11	1.80	1.75	1.90	1.75	1.00
Aug. 31.....	.35	.40	.16	.20	.11	.13	.09	.11	1.80	1.80	1.90	1.75	1.00
Oct. 19.....	.35	.40	.16	.20	.11	.13	.09	.11	1.80	1.90	1.90	1.60	1.00
1926													
Jan. 2.....	.35	.40	.16	.20	.11	.13	.09	.11	1.80	2.00	(1)	1.45	1.00

<sup>1</sup> Alfalfa hay discontinued.

NOTE.—A, received by rail; B, hauled or driven in.

## NASHVILLE UNION STOCK YARDS (INC.), NASHVILLE, TENN.

Date	Yardage, per head								Feed	
	Cattle		Calves		Hogs		Sheep		Hay per bale	Corn per bushel
	A	B	A	B	A	B	A	B		
1924										
July 1.....	\$0.30	\$0.35	\$0.15	\$0.20	\$0.12	\$0.14	\$0.10	\$0.12	\$1.75	\$1.75
Oct. 10.....	.30	.35	.15	.20	.12	.14	.10	.12	1.90	1.90
1925										
Jan. 1.....	.30	.35	.15	.20	.12	.14	.10	.12	1.90	2.00
Feb. 10.....	.35	.40	.20	.25	.12	.14	.10	.12	1.90	2.00
May 1.....	.35	.40	.20	.25	.12	.14	.10	.12	2.00	1.90
Sept. 17.....	.35	.40	.20	.25	.12	.14	.10	.12	2.25	1.90

NOTE.—Class A, received by rail; Class B, received other than by rail.

*Rates and charges for yardage and feed at 25 stockyards and changes made in such charges since July 1, 1924—Continued*

## ST. LOUIS NATIONAL STOCK YARDS, ILLINOIS

Date	Yardage per head				Feed			
	Cattle	Calves	Hogs	Sheep	Corn per bushel	Prairie hay per hundred-weight	Clover mixed hundred-weight	Oats per bushel
1924								
July 1.....	\$0.35	\$0.25	\$0.12	\$0.08	\$1.25	\$1.45	\$1.75	\$1.00
5.....	.35	.25	.12	.08	1.35	1.45	1.75	1.00
19.....	.35	.25	.12	.08	1.45	1.45	1.75	1.00
26.....	.35	.25	.12	.08	1.55	1.45	1.75	1.00
Aug. 23.....	.35	.25	.12	.08	1.65	1.45	1.75	1.00
1925								
Jan. 10.....	.35	.25	.12	.08	1.75	1.45	1.75	1.00
31.....	.35	.25	.12	.08	1.75	1.45	1.60	1.00
Apr. 25.....	.35	.25	.12	.08	1.65	1.45	1.60	1.00
Oct. 12.....	.35	.25	.12	.08	1.55	1.60	1.90	1.00
31.....	.35	.25	.12	.08	1.45	1.60	1.90	1.00
1926								
Mar. 10.....	.35	.25	.12	.08	1.35	1.60	1.90	1.00

## NEW YORK STOCK YARDS CO., NEW YORK, N. Y.

Date	Yardage per head <sup>e</sup>								Feed		
	Cattle		Calves		Hogs		Sheep		Hay, per cwt.	Corn, per bushel	Oats, per cwt.
	A	B	A	B	A	B	A	B			
1924											
July 1.....	\$0.40	\$0.50	\$0.20	\$0.25	\$0.12	\$0.15	\$0.08	\$0.10	\$2.00	\$1.50	\$1.25
Aug. 11.....	.40	.50	.20	.25	.12	.15	.08	.10	2.25	1.75	1.25
1925											
Jan. 19.....	.40	.50	.20	.25	.12	.15	.08	.10	2.25	2.00	1.25
Nov. 28.....	.40	.50	.20	.25	.12	.15	.08	.10	2.00	1.75	1.25

NOTE.—A, arriving in carload lots via rail; B, arriving other than via rail or via rail in less than carload lots.

*Rates and charges for yardage and feed at 25 stockyards and changes made in such charges since July 1, 1924—Continued*

## OKLAHOMA NATIONAL STOCK YARDS CO., OKLAHOMA CITY, OKLA.

Date	Yardage per head								Feed			
	Cattle		Calves		Hogs		Sheep		Prairie hay, per ton	Alfalfa, per ton	Corn, per bushel	Oats, per bushel
1924												
July 1.....	\$0.35		\$0.25		\$0.12		\$0.08		\$25.00	\$35.00	\$1.50	\$0.90
Aug. 1.....	.35		.25		.12		.08		25.00	35.00	1.60	.90
1925												
Jan. 10.....	.35		.25		.12		.08		25.00	35.00	1.75	.90
May 16.....	.35		.25		.12		.08		25.00	35.00	1.60	.90
Sept. 15.....	.35		.25		.12		.08		30.00	35.00	1.60	.90
	A	B	A	B	A	B	A	B	Per hundred weight	Per hundred weight	Per bushel	Per bushel
Nov. 15.....	\$0.35	\$0.40	\$0.25	\$0.27	\$0.12	\$0.14	\$0.08	\$0.10	1.50	1.75	1.60	.90
1926												
Mar. 1.....	.35	.40	.25	.27	.12	.14	.08	.10	1.50	1.75	1.50	.90

NOTE.—A, received in carload lots via railroad; B, received other than by rail in less than carload lots.

## UNION STOCKYARDS CO. OF OMAHA (LTD.), SOUTH OMAHA, NEBR.

Date	Yardage per head				Feed			
	Cattle	Calves	Hogs	Sheep	Corn, per bushel	Prairie hay, per cwt.	Alfalfa hay, per cwt.	Oats, per bushel
1924								
July 1.....	\$0.35	\$0.25	\$0.12	\$0.08	\$1.25	\$1.25	\$1.50	\$1.00
Aug. 1.....	.35	.25	.12	.08	1.50	1.25	1.50	1.00
1925								
Jan. 1.....	.35	.25	.12	.08	1.65	1.125	1.50	1.00
Apr. 13.....	.35	.25	.12	.08	1.50	1.125	1.50	1.00
Oct. 1.....	.35	.25	.12	.08	1.50	1.25	1.50	1.00
Nov. 1.....	.35	.25	.12	.08	1.40	1.25	1.50	1.00
1926								
Jan. 1.....	.35	.25	.12	.08	1.30	1.25	1.50	1.00

## PEORIA UNION STOCK YARDS CO., PEORIA, ILL.

Date	Yardage per head				Feed		
	Cattle	Calves	Hogs	Sheep	Hay, per hundred-weight	Corn, per bushel	Oats, per bushel
1924							
July 1.....	\$0.30	\$0.15	\$0.10	\$0.08	\$1.80	\$1.25	\$0.85
10.....	.30	.15	.10	.08	1.80	1.35	.85
21.....	.30	.15	.10	.08	1.80	1.50	.85
Court order docket 5.....	.22	.11	.06	.06			

NOTE.—Court order of July 16, 1924, requires that corn shall be sold at not more than 39 cents per bushel over cost delivered and hay not more than 58 cents per hundredweight over cost delivered.



*Rates and charges for yardage and feed at 25 stockyards and changes made in such charges since July 1, 1924—Continued*

## PITTSBURGH UNION STOCK YARDS CO., PITTSBURGH, PA.

Date	Yardage, per head				Feed		
	Cattle	Calves	Hogs	Sheep	Hay, per cwt.	Corn, per bushel	Oats, per bushel
1924							
July 1.....	\$0.33	\$0.20	\$0.11	\$0.07	\$1.75	\$1.40	\$1.00
11.....	.33	.20	.11	.07	1.75	1.50	1.00
25.....	.33	.20	.11	.07	1.75	1.60	1.00
Aug. 15.....	.33	.20	.11	.07	1.75	1.70	1.00
1925							
Oct. 11.....	.33	.20	.11	.07	1.75	1.60	1.00
Dec. 5.....	.33	.20	.11	.07	1.75	1.50	1.00
1926							
Jan. 15.....	.33	.20	.11	.07	1.75	1.40	1.00

## PORTLAND UNION STOCK YARDS CO., NORTH PORTLAND, OREG.

Date	Yardage, per head				Feed		
	Cattle	Calves	Hogs	Sheep	Alfalfa hay per cwt.	Wheat per cwt.	Corn per cwt.
1924							
July 1.....	\$0.30	\$0.20	\$0.10	\$0.07	\$1.40	\$2.65	\$2.50
Aug. 1.....	.30	.20	.10	.07	1.40	3.00	(1)
Oct. 17.....	.30	.20	.10	.07	1.60	3.00	-----
Nov. 7.....	.30	.20	.10	.07	1.60	3.25	-----
Dec. 27.....	.30	.20	.10	.07	1.60	3.50	-----
1925							
Jan. 31.....	.30	.20	.10	.07	1.60	4.00	-----
Apr. 24.....	.30	.20	.10	.07	1.60	3.50	-----
Nov. 20.....	.30	.20	.10	.07	1.50	3.50	-----

<sup>1</sup> Corn canceled from schedule Aug. 1, 1924.

## SIOUX CITY STOCK YARDS CO., SIOUX CITY, IOWA

Date	Yardage, per head				Feed			
	Cattle	Calves	Hogs	Sheep	Prairie hay, per cwt.	Alfalfa, per cwt.	Corn, per bushel	Oats, per bushel
1924								
July 1.....	\$0.35	\$0.25	\$0.12	\$0.08	\$1.25	\$1.70	\$1.15	\$0.75
Aug. 4.....	.35	.25	.12	.08	1.25	1.70	1.50	.75
1925								
Feb. 15.....	.35	.25	.12	.08	1.12½	1.70	1.65	.75
Apr. 13.....	.35	.25	.12	.08	1.12½	1.70	1.50	.75
Oct. 23.....	.35	.25	.12	.08	1.25	1.70	1.50	.75
31.....	.35	.25	.12	.08	1.25	1.70	1.40	.75
1926								
Jan. 8.....	.35	.25	.12	.08	1.25	1.70	1.30	.75

## 48 REPORT OF THE PACKERS AND STOCKYARDS ADMINISTRATION

*Rates and charges for yardage and feed at 25 stockyards and changes made in such charges since July 1, 1924—Continued*

## ST. JOSEPH STOCK YARDS CO., SOUTH ST. JOSEPH, MO.

Date	Yardage, per head				Feed				
	Cattle	Calves	Hogs	Sheep	Prairie hay, per cent	Alfalfa hay No. 1, per cent	Alfalfa hay No. 2, per cent	Corn, per bushel	Oats, per bushel
1924									
July 1.....	\$0.35	<sup>1</sup> \$0.25	<sup>2</sup> \$0.12	\$0.08	\$1.25	\$1.75	\$1.50	\$1.20	\$1.00
21.....	.35	1.25	1.12	.08	1.25	1.75	1.50	1.35	1.00
Aug. 1.....	.35	1.25	1.12	.08	1.25	1.75	1.50	1.50	1.00
1925									
Jan. 5.....	.35	1.25	1.12	.08	1.12½	1.75	1.50	1.65	1.00
Apr. 20.....	.35	1.25	1.12	.08	1.12½	1.50	1.50	1.50	1.00
Oct. 5.....	.35	1.25	1.12	.08	1.25	1.50	1.50	1.50	1.00
31.....	.35	1.25	1.12	.08	1.25	1.50	1.50	1.40	1.00
Dec. 21.....	.35	1.25	1.12	.08	1.25	1.50	1.50	1.30	.90

<sup>1</sup> Maximum, \$20 car.

<sup>2</sup> Maximum, \$15 car.

## ST. PAUL UNION STOCKYARDS CO., SOUTH ST. PAUL, MINN.

Date	Yardage, per head				Feed		
	Cattle	Calves	Hogs	Sheep	Corn, per bushel	Hay, per cwt	Oats, per bushel
1924							
July 1.....	\$0.30	\$0.20	\$0.10	\$0.07	\$1.25	\$1.50	\$0.75
Aug. 9.....	.30	.20	.10	.07	1.50	1.50	.75
Nov. 14.....	.30	.20	.10	.07	1.40	1.50	.75
1926							
Jan. 9.....	.30	.20	.10	.07	1.30	1.50	.75

## WICHITA UNION STOCK YARDS CO., WICHITA, KANS.

Date	Yardage, per head								Feed			
	Cattle		Calves		Hogs		Sheep		Hay, per ton	Alfalfa, per ton	Oats, per bushel	Corn, per bushel
1924												
July 1.....	\$0.35		<sup>1</sup> \$0.25		<sup>2</sup> \$0.12		\$0.08		\$25.00	\$35.00	\$0.75	\$1.40
Aug. 10.....	.35		<sup>1</sup> .25		<sup>2</sup> .12		.08		25.00	35.00	.75	1.50
1925												
Jan. 26.....	.35		<sup>1</sup> .25		<sup>2</sup> .12		.08		25.00	35.00	.75	1.65
May 1.....	.35		<sup>1</sup> .25		<sup>2</sup> .12		.08		25.00	35.00	.75	1.50
	A	B	A	B	A	B	A	B				
1926												
Feb. 8.....	\$0.35	\$0.40	\$0.25	\$0.27	\$0.12	\$0.14	\$0.08	\$0.10	25.00	35.00	.75	1.40

<sup>1</sup> Maximum, \$20.

<sup>2</sup> Maximum, \$15.

NOTE.—A, livestock received by rail; B, livestock received other than by rail.

## SCHEDULES OF MARKET AGENCIES

The following is a list of the commission charges for selling straight cars of livestock. This is not a complete schedule of charges. Separate provisions of the schedules provide charges for selling mixed car lots, drive-in livestock, and plural-owner-ship consignments of livestock. In some cases additional charges are made for extra services, such as prorating and extra sorting. The charges set forth in each instance represent those observed by the market agency members of the livestock exchanges. Where there are independent agencies operating at these markets they usually observe the regular market schedule. In a few cases they are operating on different schedules.

## BALTIMORE LIVESTOCK EXCHANGE

*Hogs*.—Minimum, 2 per cent on gross sales.  
*Calves*.—Minimum, 2 per cent on gross sales.  
*Lambs*.—Minimum, 2 per cent on gross sales.  
*Cattle*.—\$1.25 per head; maximum charge, \$30 per car. Western stock cattle, \$25 per car. On canner cattle over 1 year old which sell for \$20 or less per head, \$1 per head.

## BUFFALO LIVESTOCK ASSOCIATION

*Cattle*.—Per head, \$1, with a minimum charge of \$18 and a maximum charge of \$22 per carload.  
*Hogs*.—Per single-deck carload, \$14; per double-deck carload, \$22.  
*Sheep*.—Per single-deck carload, \$14; per double-deck carload, \$22.  
*Calves*.—Per single-deck carload, \$16; per double-deck carload, \$24.

## CHICAGO LIVESTOCK EXCHANGE

*Cattle*.—Twenty head or less, \$17, and 75 cents per head for each additional head over 20 head, with a maximum of \$21. When car contains less than 14 head, the "drive-in" schedule applies.  
*Calves*.—Single deck, 50 head or less, \$17, and 30 cents per head for each additional head over 50 head, with a maximum of \$22. Double deck, 70 head or less, \$23, and 30 cents per head for each additional head over 70 head, with a maximum of \$28. When car contains less than 40 head, the "drive-in" schedule applies.  
*Hogs*.—Single deck, 50 head or less, \$13, and 15 cents per head for each additional head over 50 head, with a maximum of \$15. An additional charge of 30 cents shall be made for each full 500 pounds weight over 17,000 pounds. Double deck, 80 head or less, \$18, and 15 cents per head for each additional head over 80 head, with a maximum of \$23. An additional charge of 30 cents shall be made for each full 500 pounds weight over 27,000 pounds. When a car contains less than 40 head, the "drive-in" schedule applies.  
*Sheep*.—Single deck, \$14. Double deck, \$20. When a car contains less than 50 head, the "drive-in" schedule applies.

## CINCINNATI LIVESTOCK EXCHANGE

*Cattle in carload lots*.—\$1 per head. Maximum, \$25 per car plus 50 cents per head for all calves contained therein.

*Calves in cars*.—50 cents per head, regardless of number (400 pounds and over to take cattle rate). Maximum for single-deck loads, \$25, and for double-deck loads, \$35.

*Hogs in carload lots*.—Single deck, \$15; double deck, \$25.

*Sheep or lambs in carload lots*.—Single deck, \$15; double deck, \$25. One hundred head and above to constitute a deck.)

## CLEVELAND LIVESTOCK EXCHANGE

*Cattle*.—\$1 per head with a minimum charge of \$18 and a maximum charge of \$22 per carload.

*Hogs*.—Per single deck, \$14; double deck, \$22.

*Sheep*.—Per single deck, \$14; double deck, \$22.

*Calves*.—Per single deck, \$15; double deck, \$22.

## DENVER LIVESTOCK EXCHANGE

*Cattle*.—Twenty head or less, \$15, and 65 cents per head for each additional head over 20 head, with a maximum of \$19. When car contains less than 14 head, the "drive-in" schedule applies.

*Calves*.—Single deck, 50 head or less, \$15, and 30 cents per head for each additional head over 50 head, with a maximum of \$20.

*Calves*.—Double deck, 70 head or less, \$21, and 30 cents per head for each additional head over 70 head, with a maximum of \$26. When car contains less than 40 head, the "drive-in" schedule applies.

*Hogs*.—Single deck, 50 head or less, \$12, and 15 cents per head for each additional head over 50 head, with a maximum of \$14. An additional charge of 30 cents shall be made for each full 500 pounds weight over 17,000 pounds.

*Hogs*.—Double deck, 80 head or less, \$17, and 15 cents per head for each additional head over 80 head, with a maximum of \$22. An additional charge of 30 cents shall be made for each full 500 pounds weight over 27,000 pounds. When a car contains less than 40 head, the "drive-in" schedule applies.

*Sheep*.—Single deck, \$14; double deck, \$20. When a car contains less than 40 head, the "drive in" schedule applies.

## DETROIT LIVESTOCK ASSOCIATION

*Cattle*.—Per carload, \$20.

*Hogs*.—Per double-deck carload, \$20.

*Hogs*.—Per single-deck carload, \$14.

*Sheep and lambs*.—Per double-deck carload, \$20.

*Sheep and lambs*.—Per single-deck carload, \$14.

*Calves*.—Per double-deck carload, \$20.

*Calves*.—Per single-deck carload, \$14.

## FORT WORTH JOINT SCHEDULE

*Cattle*.—75 cents each; \$12 minimum, \$18 maximum.

*Calves*.—35 cents each; \$12 minimum, \$18 maximum; double deck, \$30, maximum.

*Hogs*.—30 cents each; \$8 minimum, \$12 maximum; double deck \$20 maximum.

*Sheep or goats*.—20 cents each; \$8 minimum, \$12 maximum, double deck \$20 maximum.

Those in single decks where double-deck freight rates apply double-deck rates.

## INDIANAPOLIS LIVESTOCK EXCHANGE

*Cattle*, 75 cents a head; *calves*, 35 cents a head; *hogs*, 20 cents a head; *sheep and goats*, 20 cents a head.

*For single decks*.—No minimum charge on a straight unmixed load belonging to one person or partnership. Maximum for cattle, \$21; for calves, \$18; for hogs, \$12; for sheep or goats, \$12.

*For double decks*.—Minimum and maximum straight loads: Calves, minimum, \$20; maximum \$23; hogs, no minimum; maximum, \$20; sheep or goats, no minimum; maximum, \$18.



## KANSAS CITY LIVESTOCK EXCHANGE

**Cattle.**—Sec. 1. Single ownership, carload lots, 20 head or less \$15 and 65 per cent for each additional head over 20 head, with maximum of \$19. When car contains less than 14 head the "drive-in" schedule applies.

**Calves.**—Single deck; 50 head or less \$15 and 30 cents per head for each additional head over 50 head, with a maximum of \$20.

**Calves.**—Double deck; 70 head or less \$21 and 30 cents per head for each additional head over 70, with a maximum of \$26. When car contains less than 40 head, the "drive-in" schedule applies.

**Hogs.**—Single deck; 50 head or less \$12 and 15 cents per head for each additional head over 50 head, with a maximum of \$14. An additional charge of 30 cents shall be made for each full 500 pounds weight over 17,000 pounds.

**Hogs.**—Double deck; 80 head or less \$17 and 15 cents per head for each additional head over 80 head, with a maximum of \$22. An additional charge of 30 cents shall be made for each full 500 pounds weight over 27,000 pounds. When a car contains than 40 head, the "drive-in" schedule applies.

**Sheep.**—Single deck, \$14; double deck, \$20. When a car contains less than 50 head, the "drive-in" schedule applies.

## LOS ANGELES LIVESTOCK EXCHANGE

**Cattle.**—75 cents per head; \$16 per carload minimum, \$21 maximum.

**Calves.**—35 cents per head; \$16 per carload minimum, \$21 maximum; double deck, 35 cents per head; \$21 per carload minimum, \$25 maximum.

Fifteen head cattle in car shall constitute a carload; less at "drive-in" rates.

**Hogs.**—30 cents per head; \$12 per carload minimum, \$15 maximum; double-deck cars, \$24.

**Sheep or goats.**—25 cents each; single deck, \$14; double deck, \$20. Sheep or goats originating in double-deck cars, but for any reason arriving in single-deck cars, where double-deck freight rates are applied, may be sold at the double-deck rates of commission, namely, \$20 per car.

Less than 30 head of hogs or sheep, in a single-deck car, with no other stock in the car, shall be charged for at "drive-in" rates.

## LOUISVILLE LIVESTOCK EXCHANGE

**Cattle.**—Sold in carloads, \$1 per head, not to exceed \$20 per carload.

**Calves.**—50 cents per head, not to exceed \$20 per car.

**Hogs.**—In carloads 50 head or more, 8 cents per hundredweight; minimum \$10; maximum \$15 per single deck, or 8 cents per hundredweight for double deck. Any number in carloads less than 50 head, 20 cents per head.

**Sheep and lambs.**—In carloads less than 50 head, 20 cents per head; 50 to 100 head \$10 per lot; more than 100 head, 10 cents per head.

**Stock sheep.**—Less than 50 head, 20 cents per head; 50 to 70 head, \$10 per lot; more than 70 head, 15 cents per head. No maximum.

## NASHVILLE LIVESTOCK EXCHANGE

**Cattle.**—The commission for selling cattle shall be \$1 per head, with a maximum of \$20 for a straight carload of cattle. Cattle brought to the market otherwise than in railroad cars, 25 head shall constitute a carload.

**Calves.**—The commission for selling calves shall be 50 cents per head with a maximum of \$20 for a straight single deck, and a maximum of \$25 for a straight double deck of calves.

**Hogs.**—The commission for selling hogs shall be 25 cents per head up to 50 head; more than 50 head 8 cents per hundredweight; minimum \$12.50 per single deck, maximum \$15; maximum double deck \$25.

**Sheep and lambs.**—The commission for selling sheep, lambs or goats shall be 20 cents per head up to 50 head. In lots of 50 to 100 head \$10 per lot. More than 100 head 10 cents per head.

## NEW YORK AND NEW JERSEY LIVESTOCK EXCHANGE

**Cattle.**—The commission charge for selling all cattle, except yearlings, amounting to \$20 or less per head, shall be 75 cents per head. The charge for all cattle selling for amounts over \$20 per head shall be \$1.25 per head.

**Calves and yearlings.**—The commission for selling calves and yearlings weighing less than 350 pounds shall be 30 cents per head. Calves and yearlings weighing 350 pounds and over, 60 cents per head. Provided that no straight load of southern or western calves shall be sold for less than a minimum charge of \$25, actual figures to apply when commission charges on basis of above "per head" rate shall be in excess of \$25 for the load. These charges to apply on all calves and yearlings with the exception of calves off the Harlem Division of the New York Central Railroad, which are sold and weighed in lots of one or two at the Sixtieth Street Stockyards and which are usually charged for on basis of 40 cents per head.

**Sheep and lambs.**—The commission for selling sheep and lambs shall be 15 cents per head.

**Hogs.**—The commission for selling hogs shall be 2 per cent gross.

## OKLAHOMA NATIONAL LIVE STOCK EXCHANGE

**Cattle.**—80 cents each; \$17 minimum, \$22 maximum.

**Calves.**—40 cents each; \$17 minimum; \$22 maximum; double-deck cars \$25 maximum.

**Hogs.**—30 cents each; \$12 minimum; \$15 maximum; double deck \$24 maximum.

**Sheep or goats.**—25 cents each; \$12 minimum; \$15 maximum; double deck \$24 maximum.

Those in single deck where double-deck freight rates apply double-deck rates.

## OMAHA LIVE STOCK EXCHANGE

**Cattle.**—Twenty head or less, \$15, and 70 cents per head for each additional head over 20 head, with a maximum of \$19. When car contains less than 14 head, the "drive-in" schedule applies.

**Calves.**—Single deck, 50 head or less, \$15, and 30 cents per head for each additional head over 50 head, with a maximum of \$20, double deck, 70 head or less, \$21, and 30 cents per head for each additional head over 70 head, with a maximum of \$26. When car contains less than 40 head, the "drive-in" schedule applies.

**Hogs.**—Single deck, 50 head or less, \$12, and 15 cents per head for each additional head over 50 head, with a maximum of \$14. An additional charge of 30 cents shall be made for each full 500 pounds weight over 17,000 pounds. Double deck, 80 head or less, \$17, and 15 cents per head for each additional head over 80 head, with a maximum of \$22. An additional charge of 30 cents shall be made for each full 500 pounds weight over 27,000 pounds. When a car contains less than 40 head, the "drive-in" schedule applies.

**Sheep.**—Single deck, \$14 double deck, \$20. When a car contains less than 40 head, the "drive-in" schedule applies.

## PEORIA LIVESTOCK EXCHANGE

**Cattle.**—Twenty head or less, \$17, and 75 cents per head for each additional head over 20 head, with a maximum of \$21. When car contains less than 14 head, the "drive-in" schedule applies.

**Calves.**—Single deck, 50 head or less, \$17.50, and 30 cents per head for each additional head over 50 head, with a maximum of \$22; double deck, 70 head or less, \$23, and 30 cents per head for each additional head over 70 head, with a maximum of \$28. When car contains less than 40 head, the "drive-in" schedule applies.

**Hogs.**—Single deck, 50 head or less \$13, and 15 cents per head for each additional head over 50 head, with a maximum of \$15. An additional charge of 30 cents shall be made for each full 500 pounds

weight over 17,000 pounds. Double deck, 80 head or less, \$18, and 15 cents per head for each additional head over 80 head, with a maximum of \$23. An additional charge of 30 cents shall be made for each full 500 pounds weight over 27,000 pounds. When a car contains less than 40 head, the "drive-in" schedule applies.

*Sheep*.—Single deck, \$14; double deck, \$20. When a car contains less than 50 head, the "drive-in" schedule applies.

#### PITTSBURGH LIVESTOCK EXCHANGE

*Cattle*.—\$1.25 per head; maximum per car, \$25.

*Hogs*.—\$15 per single deck; \$25 per double deck.

*Sheep*.—\$15 per single deck; \$25 per double deck.

*Calves*.—\$18 per single deck; \$28 per double deck.

#### PORTLAND LIVESTOCK EXCHANGE

*Cattle*.—75 cents per head; minimum, \$15; maximum, \$18.75.

*Calves*.—40 cents per head; minimum, \$15; maximum, \$18.75. Double deck, 40 cents per head; minimum, \$20; maximum, \$25.

*Hogs*.—25 cents per head. Single-deck cars, minimum, \$10; maximum, \$12.50. Double-deck cars, minimum, \$15; maximum, \$18.75.

*Sheep or goats*.—Single-deck cars, \$12.50; double-deck cars, \$18.75. Sheep originating in double-deck cars but for any reason arriving in single-deck cars where double-deck freight rates are applied may be sold at the double-deck rate of commission, viz, \$18.75.

#### SIOUX CITY LIVESTOCK EXCHANGE

*Cattle*.—Twenty head or less, \$16, and 75 cents per head for each additional head over 20 with a maximum of \$21. When a car contains less than 14 head "drive-in" schedule applies.

*Calves*.—Single-deck, 50 head or less, \$16, and 35 cents per head for each additional head over 50 head, with a maximum of \$21; double deck, 70 head or less, \$21 and 35 cents per head for each additional head over 70 with a maximum of \$27. When a car contains less than 40 head "drive-in" schedule applies.

*Hogs*.—Single-deck, 50 head or less, \$12 and 25 cents per head for each additional head over 50, with a maximum of \$14. An additional charge of 30 cents for each full 500 pounds weight over 16,500. Double deck, 80 head or less, \$17 and 25 cents per head for each additional head over 80, with a maximum of \$22. An additional charge of 30 cents shall be made for each full 500 pounds weight in excess of 24,000 pounds. When a car contains less than 40 head, the "drive-in" schedule applies.

*Sheep*.—Single deck, \$14; double deck, \$20. When the car contains less than 50 head the "drive-in" schedule applies.

#### SOUTH ST. JOSEPH LIVESTOCK EXCHANGE

*Cattle*.—Twenty head or less, \$15, and 65 cents per head for each additional head over 20 head, with a maximum of \$19. When a car contains less than 14 head, the "drive-in" schedule applies.

*Calves*.—Single deck, 50 head or less, \$15, and 30 cents per head for each additional head over 50 head, with a maximum of \$20; double deck, 70 head or less, \$21, and 30 cents per head for each additional head over 70 head, with a maximum of \$26. When a car contains less than 40 head, the "drive-in" schedule applies.

*Hogs*.—Single deck, 50 head or less, \$12, and 15 cents per head for each additional head over 50 head, with a maximum of \$14. An additional charge of 30 cents shall be made for each full 500 pounds weight over 17,000 pounds. Double deck, 80 head or less, \$17, and 15 cents per head for each additional head over 80 head, with a maximum of \$22. An additional charge of 30 cents shall be made for each full 500 pounds weight over 27,000 pounds. When a car contains less than 40 head, the "drive-in" schedule applies.

*Sheep*.—Single deck, \$14; double deck, \$20. When a car contains less than 50 head the "drive-in" schedule applies.

#### ST. LOUIS LIVESTOCK EXCHANGE

*Cattle*.—Twenty head or less, \$17 and 75 cents per head for each additional head over 20 head, with a maximum of \$21. When a car contains less than 14 head, the "drive-in" schedule applies.

*Calves*.—Single deck, 50 head or less, \$17 and 30 cents per head for each additional head over 50 head, with a maximum of \$22; double deck, 70 head or less, \$23 and 30 cents per head for each additional head over 70 head, with a maximum of \$28. When a car contains less than 40 head, the "drive-in" schedule applies.

*Hogs*.—Single deck, 50 head or less, \$13, and 15 cents per head for each additional head over 50 head, with a maximum of \$15. An additional charge of 30 cents shall be made for each full 500 pounds weight over 17,000 pounds. Double deck, 80 head or less, \$18, and 15 cents per head for each additional head over 80 head, with a maximum of \$23. An additional charge of 30 cents shall be made for each full 500 pounds weight over 27,000 pounds. When a car contains less than 40 head, the "drive-in" schedule applies.

*Sheep*.—Single deck, \$14; double deck, \$20. When a car contains less than 50 head, the "drive-in" schedule applies.

#### ST. PAUL LIVESTOCK EXCHANGE

*Cattle*.—Twenty head or less, \$15, and 65 cents per head for each additional head over 20 head, with a maximum of \$19. When a car contains less than 14 head, the "drive-in" schedule applies.

*Calves*.—Single deck, 50 head or less, \$15, and 30 cents per head for each additional head over 50 head, with a maximum of \$20; double deck, 70 head or less, \$21, and 30 cents per head for each additional head over 70 head, with a minimum of \$26. When a car contains less than 40 head, the "drive-in" schedule applies.

*Hogs*.—Single deck, 50 head or less, \$12, and 15 cents per head for each additional head over 50 head, with a maximum of \$14. An additional charge of 30 cents will be made for each full 500 pounds weight over 17,000 pounds. Double deck, 80 head or less, \$17, and 15 cents per head for each additional head over 80 head, with a maximum of \$22. An additional charge of 30 cents will be made for each full 500 pounds weight over 27,000 pounds. When a car contains less than 40 head, the "drive-in" schedule applies.

*Sheep*.—Twenty cents per head; single deck, \$14; double deck, \$20. When a car contains less than 70 head, the "drive-in" schedule applies.

#### WICHITA LIVESTOCK EXCHANGE

*Cattle*.—75 cents each; \$20 maximum.

*Calves*.—35 cents each; \$20 maximum; double decks, 35 cents each; \$25 maximum.

*Hogs*.—25 cents each; \$14 maximum; double decks, 25 cents each; \$20 maximum.

*Sheep or goats*.—25 cents each; \$14 maximum; double decks, 25 cents each; \$18 maximum.

Those coming in single decks where double-deck freight rates apply, double-deck rates.

(E) In the early part of this report (pages 5 to 8) a rather detailed statement is made relative to trade practices, in which are outlined the activities of the administration in investigating and bringing about correction in discriminatory, unfair, and otherwise unlawful practices. The formal proceedings involving trade practices are covered in the list of formal



dockets beginning at page 11. The list shows the pending cases and those terminated, with the reasons therefor. Since the last report, 28 orders to cease and desist were issued in trade practice cases, in 5 cases the market agency or dealer was suspended for a specified period, 20 cases were dismissed, and 6 cases are pending.

### SUGGESTIONS AS TO THE ACT

Experience in the administration of the act has demonstrated the necessity of two important amendments, the first for the purpose of subjecting to its disciplinary measures employees of registrants who actually participate in a wrongful practice, the second to put the burden of proof upon any market agency or stockyards company seeking to increase its rates and charges.

The amendment made by the agricultural appropriation act of June 5, 1924 (43 Stat. 432, 460), authorizes the suspension for a reasonable specified period of any registrant who has violated any provisions of the act. This clearly applies solely to persons who have registered in accordance with section 303, either as market agencies or dealers, and does not include their employees. They are accordingly not subject to discipline even though individu-

ally culpable in the highest degree, but are free to accept employment by other concerns. An amendment requiring employees to register would therefore be of considerable value in correcting bad practices.

In dealing with rates and charges the act follows similar legislation respecting rate regulation by the Interstate Commerce Commission. In the railroad cases the burden of proving that a proposed increase is just and reasonable is placed upon the carrier by an amendment to the interstate commerce act approved June 18, 1910 (36 Stat. 552), the pertinent provision of which is:

At any hearing involving a rate, fare, or charge increased after January 1, 1910, or of a rate, fare, or charge sought to be increased after the passage of this act, the burden of proof to show that the rate, fare, or charge, or proposed increased rate, fare, or charge is just and reasonable shall be upon the carrier, and the commission shall give to the hearing and decision of such questions preference over all other questions pending before it and decide the same as speedily as possible.

But under the packers and stockyards act the Secretary must assume the burden of proving the unreasonableness of proposed rates. It would seem that the rule should be the same as in the railroad cases. An amendment to that effect would greatly facilitate the administration of the act in this particular.









DEC 14 1926  
Saturday, December 11, ( p m )

EXPERIMENT STATION  
P. I.

## REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF PLANT INDUSTRY,  
Washington, D. C., August 31, 1926.

SIR: I have the honor to submit herewith a report of the work of  
the Bureau of Plant Industry for the fiscal year ended June 30, 1926.

Respectfully,

WM. A. TAYLOR,  
*Chief of Bureau.*

HON. W. M. JARDINE,  
*Secretary of Agriculture.*

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### A QUARTER CENTURY OF SERVICE

The Bureau of Plant Industry was established by statute July 1, 1901, combining and enlarging the activities of five previously separate divisions of the department: Gardens and grounds, vegetable pathology and physiology, pomology, botany, and agrostology.

The completion of the fiscal year 1926 brings the bureau to the twenty-fifth anniversary of its formal organization, and it is fitting that a brief review be recorded of some of the striking accomplishments of this quarter century.

Throughout this period the bureau has been primarily a research organization, employing specialists trained in any science bearing in any manner upon the crop problems selected for critical study. National progress in agriculture through intelligent appreciation of existing facts and through the development of new ideas directly or indirectly related to crop production and plant growth has been the underlying purpose of the bureau. Some of its activities have accordingly dealt more with general agricultural efficiency than with crop handling—for example, the organization of farm-management studies, now a branch of the Bureau of Agricultural Economics; the employment of local agricultural advisers of farm demonstration agents, now enlarged into the Smith-Lever extension, States and Federal Government cooperating; studies of rural organization and systems of agricultural marketing, later organized as the Bureau of Markets and now a part of the Bureau of Agricultural Economics;

all these began as offices or branches of the Bureau of Plant Industry and developed until their size or relation to other branches of the department rendered their transfer expedient.

Studies of the algæ and bacteria affecting the potability of water—perhaps the least agricultural of all the bureau's researches and accordingly discontinued—have had a stimulating influence upon the sanitary improvement of water supplies, especially in dairy regions.

The most numerous and perhaps the most significant of the bureau's contributions toward the Nation's economic progress, however, have been the establishment of new industries, the introduction of new plants, the development of new methods of plant culture or handling, or other new ideas involving plant production or plant science.

Identifying and determining the causes of destructive plant diseases and the development of methods for their control, especially when major crops were involved, has always been one of the principal phases of the bureau's activities. In most instances the researches on fruit or field-crop diseases have led to practical methods for partial or complete control.

### BENEFITS OF DISEASE CONTROL

While there is no question that very great benefit in the production of many crops resulted from methods of disease control established by the bureau, it is difficult in most cases to estimate this benefit in dollars and cents. Some items which can be esti-



mated with a reasonable degree of accuracy are as follows:

For the prevention of bunt disease of wheat the copper-carbonate treatment was applied to the seed sown on at least 3 300,000 acres in 1925. More recent data are not available, but in view of the fact that a large acreage in Minnesota, the Dakotas, and Montana was sown with copper-carbonate-treated seed in the spring of 1926, it seems safe to estimate that one-tenth of the total 57,000,000 acres of wheat grown in the United States during the current year was sown with seed treated with copper carbonate. On the basis of reduced bunt infection, improved germination in comparison with ordinarily disinfected seed, better stands, saving in seed requirements, etc., the net gain of this seed treatment, developed in the cooperative work of the department and the State experiment stations, is at least 5,000,000 bushels, and in all probability this may be effected annually.

The discovery that heat canker of flax can be largely controlled by earlier seeding has resulted in a much wider application of this practice. On the average, better yields are obtained from early seeding, so the value resulting from this discovery is much greater than the direct one resulting from the control of the canker itself. It is probably quite conservative to estimate a gain of at least 500,000 bushels annually from earlier seeding.

The average annual benefit from the control of black rot and mildew of the grape and other diseases of grapes, small fruits, and cranberries through methods of spraying discovered or improvements devised by the department, while impossible of exact determination, is known to be very great.

In the prevention of peach-leaf curl and California peach blight through methods of spraying discovered by the department an annual saving of about 2,000,000 bushels of peaches has been brought about.

The development of self-boiled lime-sulphur spray gave growers control of brown rot and scab of peaches, and to growers of stone fruits this has saved 12,000,000 bushels annually.

The development of successful spraying and sanitation for apple bitter rot, blotch, scab, and scald, and the development of the oiled wraps for apples have approximated annual gains or savings of 20,000,000 bushels of merchantable fruit.

The methods developed for combating citrus scab, melanose, stem-end rot, blue-mold rot, dieback, chlorosis, and foot rot have resulted in an annual

saving of about 500,000 boxes of citrus fruit.

Previous to the 1909 orange crop the losses sustained by the California orange growers from the rotting of oranges in transit ranged from 8 to 20 per cent of the total shipment, averaging around 12 per cent. The investigational work of the bureau which showed the necessity of careful handling of oranges clearly demonstrated that it was feasible to reduce the losses from rot in transit from the averages then prevailing to around 2 per cent. In addition to the actual increase in quantity of sound oranges delivered in the markets, the unit value of the crop has been decidedly increased by the improved methods of handling, including more efficient refrigeration equipment and practice. The general appearance and condition of the fruit are so superior at the time of delivery at the market that its selling value is very much greater than was possible when so large a percentage of deterioration took place during the transit period.

#### CAMPAIGNS AGAINST PLANT DISEASES

Three extensive direct-service campaigns to put into effect results of research work in the control of important plant diseases have been developed in cooperation with the States concerned, as follows:

The campaign for the eradication of citrus canker, a bacterial disease of citrus fruits and trees, was undertaken in 1915, in cooperation with the Gulf States, namely, Florida, Alabama, Louisiana, Mississippi, and Texas. The disease has now been practically eliminated from the greater portion of the commercial citrus-growing region, and, with the exception of scattered infections of nursery stock in Louisiana, no new infections have been reported recently. There is no question that the large citrus industry in Florida has been saved by this intensive campaign.

The cooperative program for the control of white-pine blister rust, a parasitic fungus affecting alternately white pines and currant and gooseberry bushes, was undertaken in 1917, when from the preliminary work it had become apparent that the rust was so widespread that it could not be eliminated from the country. By 1921 it had been conclusively demonstrated that local control of the rust could be practically and effectively accomplished under eastern forest conditions by the eradication of all currants and gooseberries within 900 feet of

white-pine stands, and in 1922 an 8-year cooperative control program, including eradication of currants and gooseberries from the pine stands and their immediate vicinities, was undertaken with New York and the New England States. In 1921 the rust was found in western Washington and in British Columbia, and, since the Idaho white-pine belt and other pine regions were threatened with the spread of the disease, a cooperative 10-year program was inaugurated in 1924 with California, Oregon, Washington, Idaho, and Montana to delay the spread of the disease and to develop control measures.

The campaign to eradicate the common barberry, for the purpose of reducing stem-rust losses of small grains, was undertaken in 1917 with Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming. It is evident that barberry eradication is a material aid in the solution of the stem-rust problem. A single infected barberry bush has been known to cause a local loss to wheat growers, in one township in one year, of more than 10,000 bushels of grain. In the eastern winter-wheat producing States of the eradication area stem rust of wheat is controlled as soon as the barberries are eradicated from a locality. If the more than 12,000,000 harmful barberry bushes, seedlings, and sprouting bushes already destroyed had been allowed to continue to grow in grain-producing areas of the United States there is no question that the grain crop would have been many times more severely jeopardized every year than with these centers of infection eradicated.

#### VALUABLE CEREAL INTRODUCTIONS

Among the first of the major activities of the bureau was the study of foreign cereals and the selection and introduction of certain important varieties for trial in the United States. Both introduction of selected strains and purification of these strains by careful selection have been continued during the entire quarter century. The first introduction of a new grain upon a large scale was the establishment of the durum varieties of wheat, introduced from Russia by the late M. A. Carleton, for many years in charge of the cereal office of the bureau, which are adapted to certain of the more severe climates of the United States where the varieties of wheat previously grown were unsuited.

For at least the last 15 years the increase in wheat production from the establishment of durum wheats as compared with the use of other varieties has been more than 20,000,000 bushels annually.

Among other important cereals introduced by the bureau are the following:

Turkey, Kharkof, and other hard winter wheats were introduced in localities where other winter wheats would fail, and these hardier varieties also increased the yield in other districts, resulting in an annual gain of 10,000,000 bushels.

Five wheats, introduced or bred and distributed by this bureau in cooperation with the States named, have proved extremely valuable to wheat-growing farmers. These are Federation and Hard Federation, introduced from Australia and now occupying about 500,000 acres in Oregon and Idaho; Kota, a hard spring wheat developed in North Dakota and now occupying about 1,000,000 acres in the Dakotas; Karmont, a hard winter wheat developed in Montana, where it occupies about 350,000 acres; and Forward, developed in New York and now occupying about 25,000 acres in that State and Pennsylvania. The total estimated area is 1,875,000 acres.

Sixty-Day and Swedish Select oats, introduced by the bureau, together with the four new varieties, Albion, Richland, Iowar, and Iogren, developed in cooperation with the Iowa Agricultural Experiment Station, and the six new varieties, Comewell, Cornellian, Empire, Ithacan, Standwell, and Upright, produced in cooperative breeding at Cornell University, have resulted in increased oat production exceeding 30,000,000 bushels annually.

Three improved barley varieties developed cooperatively by the bureau have a place in commercial culture. Club Mariout, selected from an Egyptian variety, was developed cooperatively in Oregon and now occupies about 350,000 acres in California. Trebi, selected from an introduction from Asia Minor, was developed cooperatively in Idaho, where it now occupies about 100,000 acres. Alpha, a hybrid variety developed cooperatively in Minnesota and New York, now occupies 30,000 acres in New York. The three varieties thus occupy about 480,000 acres.

#### DEVELOPMENT OF SORGHUMS

Since 1903, extensive studies of the classification, adaptation, culture, and improvement of the sorghums have



been in progress, particularly with grain-producing varieties. Several hundred introductions have been made, chiefly from Africa, India, and China. All available domestic strains have been assembled and tested. This work was well under way at the time when the great cattle ranches of the southern portions of the Great Plains area were giving way before the incoming farm settlers. The studies outlined have resulted in the production of several very valuable varieties, now widely grown in that region. Among these results are the selection of uniform strains of Standard milo, the improvement of the dwarf, early, and drought resistance Dwarf Yellow milo, and the breeding of Dawn kafir, a dwarf and early Blackhull, and of Sunrise kafir, an early and somewhat sweet variety of standard Blackhull. Another contribution was the introduction of feterita from Africa and the selection of dwarf and early strains. These experiments have been conducted in cooperation with State agricultural experiment stations and other agencies. The development of these improved and adapted varieties, and of proper methods of growing, threshing, and storing them, has played a large part in making possible the settlement and extension of safe farming into the drier parts of the central and southern portions of the Great Plains area by furnishing both grain and roughage for horses, cattle, hogs, and poultry.

#### CITRUS IMPROVEMENT BY BUD SELECTION

A striking illustration of benefit to the citrus industry as an outgrowth of research work is that resulting from the bud selection for nursery propagation, based upon tree-performance records. The low per-acre production of oranges previous to the inauguration of the improvement of orchards by bud selection was so small that the annual output per acre averaged only about 1 box per tree, and at a tree price of less than \$1 per box the income was hardly sufficient to maintain the groves even at the then low cost of labor. With the improvements resulting from bud selection and an equal number of acres in oranges, the per-acre production has very greatly increased, so that the industry during recent years has been fairly remunerative and in some particular groves highly remunerative. The elimination of the nonproductive and nonpaying trees through top working them with productive strains, and the planting of

new orchards the trees of which were propagated from highly productive parent trees, have resulted in a decided increase in total production with a relatively small increase in the total acreage devoted to the industry. It is very difficult to estimate the value which this activity has really contributed to the industry. Like compound interest, it accrues each year with the recurrence of the annual crop, and as the trees grow older and larger and produce more the effects of the system become more and more apparent both in the harvest and in the total profit of the industry. It is safe to say that several millions of dollars have been contributed to the citrus industry of California as a result of the elimination of nonproductive trees through the principles of fruit improvement by bud selection.

#### IMPROVED COTTON PRODUCTION

As a result of intensive studies of cotton-production problems in the United States by specialists of the bureau, superior varieties of cotton have been bred, while others have been discovered and introduced from abroad and developed in this country, including such varieties as Acala, Lone Star, Columbia, Trice, Foster, Express, Durango, Meade, and Pima. The Acala cotton, a superior upland variety producing a premium staple, was discovered in 1906 in a remote region of southern Mexico by an expedition sent out by this department. It was introduced, selected, and established in cultivation in the United States. It is estimated that the 1925 cotton crop of California and the Mexican Imperial Valley (practically all of the Acala variety) had a value of \$27,200,000. For the 7-year period from 1919 to 1925, inclusive, the cotton crop of California, including the Imperial Valley district in Lower California, had a total value of \$126,543,000, which was largely the result of planting superior varieties of cotton introduced and developed by the specialists of this bureau. With the exception of a small acreage of the Pima Egyptian cotton in the Salt River Valley of Arizona, practically the entire irrigated cotton area of western Texas, New Mexico, Arizona, and California is now producing Acala cotton. The Acala cotton is also being grown on hundreds of thousands of acres in the natural rainfall regions of Texas, Oklahoma, and Arkansas.

As a further result of the cotton-breeding investigations of the bureau,



a fundamental reform of the system of cotton production is now going forward, based on the principle of each community restricting itself to the production of a single variety of cotton. Such restriction was proved by the bureau specialists to be necessary in order to keep the seed pure and the varieties uniform, but many other advantages of community production are being demonstrated where the system is in actual operation, in California and other southwestern States. The State Legislature of California has passed a special act for the protection of one-variety communities, now recognized as essential to the cotton industry in that State.

The methods of growing cotton have been revolutionized in recent years by the new method of thick spacing of "single-stalk" plants, based on a technical botanical discovery by the specialists of this bureau that the cotton plant has two distinct kinds of branches. The single-stalk cotton is earlier and more productive, especially under boll-weevil conditions or in short seasons. The yields are often increased from 10 to 30 per cent, or even from 50 to 100 per cent or more under some conditions, by the new method.

#### SUDAN GRASS AND SOY BEANS

Sudan grass, a valuable grass sorghum and annual hay plant, was obtained in 1909 from northern Africa through the efforts of the late C. V. Piper, then agrostologist in charge of the bureau's Office of Forage Crops. It was immediately successful, particularly in the southern Great Plains, and in 1918, nine years after its introduction into the United States, the value of the annual crop of Sudan grass was conservatively estimated at \$10,000,000. Like the sorghums, it has proved able to survive periods of drought, and its fondness for hot weather during its growing period has resulted in its extensive use as a summer pasture, not only in the Great Plains but also in the Corn Belt. The acreage has practically doubled since 1918 and is becoming more or less stationary around 1,000,000 acres sown annually. Sudan grass is appreciated as an emergency hay crop and summer pasture grass in Iowa almost as much as in Texas, and the interest in it is increasing in States as far east as Ohio. It has supplanted millet to a considerable extent as a catch crop on account of its ordinarily higher yields and the greater palatability of the Sudan-grass hay. The seed is now abundant and fairly cheap,

and this grass promises to continue as one of our regular forage producers, returning each year in this one crop many times the entire annual expense of forage investigations in the bureau.

No single agency has done more to develop the soy-bean industry in the United States than has this bureau. Introduced from the Orient many decades ago, the soy bean only recently attained a recognized place in the cropping system of American farmers. As late as 1917 less than 500,000 acres were devoted to the growing of soy beans for all purposes. In 1924 there was a total of 2,500,000 acres, of which about 1,000,000 acres were used for hay, 1,000,000 acres for pasture and silage, and 500,000 acres for seed. This enormous increase in the acreage devoted to soy beans in the United States is largely due to the development of better adapted varieties. Previous to 1898 there were not more than eight varieties of soy beans generally grown in the United States, and of these only two, the Ito San and the Mammoth Yellow, are now grown to any extent. In 1924, the last year for which data are available, the total value of the seed of all varieties of soy beans grown in the United States was estimated at \$23,917,500. Of this total, about one-half probably should be credited to new varieties introduced by the bureau.

#### AIDING DRY FARMING ON THE GREAT PLAINS

There are many cases where scientific experiments and advisory work are very closely correlated and the economic advantage of the work to the Nation is clearly indicated, although there seems to be no way of estimating either the losses likely to have resulted if the bureau's work had not been carried on or the value of specific developments more or less distinctly originated by the bureau.

For much of the last 50 years the Great Plains was an area unusually subject to misrepresentation, partly through the desire of large landholders to sell, and perhaps sometimes to sell the same areas repeatedly to successive groups of settlers, but without doubt largely because of the fundamental ignorance of the unusual climatic conditions prevailing there and their direct relation to the agricultural problems involved. Investigations of methods of dry-land agriculture were undertaken to clarify the conflicting reports of the character of agricultural development that might be practicable throughout the Great

Plains and to establish a slow and steady program of permanent agricultural development.

In a region of fluctuating precipitation, such as the Great Plains, where conditions may vary from extreme drought and crop failure to abundant rainfall and bumper crops, it is only through the results of tests covering a series of years long enough to be representative of both the average and the extreme conditions to be met that determinations of agricultural practice can be made. This was recognized from the inauguration of comprehensive field experimentation, but is further emphasized by each year's extension of the record. Though much is still to be desired in the way of knowledge of the possibilities and the best methods of agriculture for this section, the information now in hand is more trustworthy than has been heretofore available.

The results of the work group themselves in three related but rather distinct fields: (1) The determination of the possibilities and limitations of agriculture in each section; (2) the determination of the cultural methods by which individual farmers in each section can realize the greatest and most profitable production; and (3) the determination of fundamental laws and principles of dry farming which may be applied beyond the actual zone of experimentation.

The conservation of moisture is the all-important major problem of dry-land agriculture, and can be subdivided into a very large number of minor problems, such as depth and manner of plowing; tillage after plowing for preparation of a seed bed; intertillage between rows during growth of rowed crops; alternate cropping and summer tillage of various degrees of intensity and at longer or shorter intervals of time; rotations and crop sequence; selection and adaptation of various crops for different localities and soils; method, rates, and time of seeding; time and methods of harvesting; utilization of crops so as most completely to conserve the scanty rainfall and to insure a continuous supply of sustenance for the farmer's family and his livestock; and the establishment of shelter belts around the farmstead for the protection of the home and the kitchen garden, orchard, small-fruit, and ornamental plantings.

#### AGRICULTURE ON IRRIGATION PROJECTS

To encourage and aid in the development of agriculture on Government

reclamation projects, work was directed toward the promotion of specific agricultural industries for which the conditions confronting the settlers on these projects formed two classes: (1) Problems of crop production, and (2) problems of crop disposal or utilization. Of the two, the problems of crop disposal or utilization were generally the more acute. The isolated locations of the irrigated areas made it impracticable to ship to the consuming centers the bulk of the farm crops produced, particularly in view of the fact that approximately 80 per cent of the cropped area of the projects was devoted to the production of forage and grain crops. Profitable utilization of these crops necessitated the establishment of livestock industries. The improvement and maintenance of productivity of the soil also required that livestock be fed upon the farms, so that the manure could be applied to the land. In view of these facts, the major portion of the work of the bureau on the projects was directed toward the establishment of livestock industries.

On a few of the projects there were acute problems of crop production affecting all crops. On a large number of the projects serious production problems were encountered only in connection with crops which were desired to supplement other crops which were produced abundantly.

#### CUMULATIVE VALUE OF RESEARCH ACTIVITIES

It is recognized that no accurate monetary expression can be made of the economic gains more or less directly resulting from the research activities of the bureau. For comparative purposes, however, expression of these economic gains has been attempted on the basis of average prices prevailing during the times when the work of the bureau brought about the improvements or other changes referred to. On this basis these items would amount to considerably more than \$200,000,000 annually, which is more than fifty times as large as the total annual appropriation for the bureau's activities, and, furthermore, even this large sum does not satisfactorily represent the benefits actually due directly or indirectly to researches of the bureau.

The vital essential to any effective adjustment of crop acreage to the market requirements of the time is approximate stabilization of crop production. This can be approached only when crop pests are measurably under control and when crop varieties are



available which are thoroughly adapted to the climate and to the soil when it is handled effectively. Enough progress has been made in these directions to warrant increased and sustained research effort in this field.

The farming public has derived significant though intangible benefits from the introduction of something over 65,000 different plants procured by agricultural explorers in various foreign countries and distributed through botanic gardens and State agricultural experiment stations and to individual plant specialists. Among these the Deglet, Noor, Thoory, Saidy, and Zahidi dates, an unusually complete collection of avocado varieties, the Chinese dry-land elm, the Meyer lemon, the Capulin cherry, the Barouni olive, the dasheen, the mango, and the litchi appear especially promising.

Benefits have resulted from the amelioration of injury caused by diseases through the breeding and dissemination of resistant varieties or through the establishment of control by spraying or rotation systems or by identifying diseased plants promptly and by roguing out diseased plants before injury by the disease has become widespread. The latter method has proved exceptionally valuable in combating the injury of mosaic diseases, especially in sugar cane and in potatoes. As a result of the control of virus diseases of potato through seed improvement, 15 to 30 per cent larger yields are being obtained.

Bacteriological and chemical studies of agricultural soils have led to efficient control of certain of the important soil bacteria and to more economical handling of fertilizers. Studies on comparative farm and market quality of large numbers of different varieties of fruits and vegetables and improvements in handling, storing, and methods of utilization of plant products have been of great value.

Development of improved hybrid blueberries, improved methods for producing dates of exceptional quality, and development of the tangelo, limequat, citrangequat, and new varieties of the Satsuma group of oranges are among the significant achievements.

## WORK OF THE FISCAL YEAR 1926

The investigations under way in the bureau during the last fiscal year have been, in general, those of indefinite duration, as problems may frequently be under consideration for extended periods of years before definite conclusions can be reached. The publica-

tions prepared by specialists of the bureau report in detail the progress of many of these lines of investigation; but even the publications, although extensive, do not completely represent the range of activities under way, since a large portion of the service rendered is in the form of advisory correspondence to individuals, county agents, and associations, based upon investigations but partially completed and unsuitable for formal publication before several years' additional experimentation. With the development and enlargement of cooperative extension activities and the establishment of the radio and other news services, this advisory activity has rapidly become more important.

The work actively prosecuted during the past fiscal year is indicated briefly as follows, supplemented by a list of the articles issued from the bureau during the year:

## ORGANIZATION AND ACTIVITIES

The general administration of the bureau's investigations is directed by W. A. Taylor, chief of bureau; K. F. Kellerman, associate chief of bureau; and H. E. Allanson, assistant to the chief of bureau.

The pathological laboratory is directed by Erwin F. Smith, senior pathologist in charge. The problems dealt with involve laboratory, greenhouse, and field experiments with bacterial diseases of crop and ornamental plants.

The office of mycology and disease survey is directed by C. L. Shear, senior pathologist in charge. Specimens of all plant parasites and other fungi having relation to injury or destruction of economic plants and plant products are collected, identified, and preserved. The geographic distribution, prevalence, and rate of spread of plant diseases in the United States and estimates of losses caused by disease are recorded, as well as the appearance of new or dangerous diseases and epidemics or unusual outbreaks of disease.

The office of fruit diseases is directed by M. B. Waite, senior pathologist in charge. Fungous, virus, and physiological diseases of fruits and fruit trees, including citrus and subtropical fruits, grapes, and small fruits, the fruit rots and decays, and diseases of the pecan and other nuts, are studied, and large-scale experiments in control by spraying, disinfection, eradication, and other methods are conducted.



The office of citrus canker eradication is directed by the associate chief of bureau. In cooperation with the Gulf States, citrus canker, a bacterial disease of citrus fruits and trees, is being systematically eradicated by the thorough inspection of nurseries and citrus groves, formalin treatment of infected soil, protective spraying of groves exposed to infection, and destruction of diseased trees.

The office of forest pathology is directed by Haven Metcalf, senior pathologist in charge. Investigations of diseases of forest and shade trees of serious economic importance, such as white-pine blister rust, chestnut blight, heart rot of Douglas fir, and blue-stain deterioration of timber, are under way with a view to the control of the diseases.

The office of blister rust control is directed by S. B. Detwiler, senior pathologist in charge. Programs for the suppression and control of the white-pine blister rust in the eastern and western United States are being prosecuted in cooperation with the affected States.

The office of vegetable and forage diseases is directed by H. A. Edson, senior pathologist in charge. Fungous and virus diseases of vegetables and forage and other crops, including incidental work on cotton and ornamentals, are investigated to determine their cause, conditions under which they develop, localities where they are most serious, the losses incurred, the methods of disease transmission, the means of overwintering, and to develop control measures. Similar investigations are carried on in cooperation with the Bureau of Agricultural Economics in connection with the transit, marketing, and storage of vegetables, to determine whether the troubles encountered originate in the field or after shipment.

The office of crop physiology and breeding is directed by W. T. Swingle, senior physiologist in charge. Breeding and cultural experiments are carried on with citrus fruits to secure new fruits equal in quality to the standard sorts now grown commercially but possessing a greater degree of resistance to cold and disease, with dates to establish commercial date culture in the United States and to create new varieties especially suited to American conditions, and with Smyrna figs and pistaches.

The office of soil bacteriology is directed by the associate chief of bureau. Experiments with pure cultures of legume bacteria are carried on

throughout the United States, and commercial cultures for legume inoculation are inspected to determine those of inferior quality. Rotation experiments are conducted in the field and in the greenhouse to determine whether the nitrogen balance of the soil can be maintained without using chemical fertilizers.

The office of soil fertility is directed by Oswald Schreiner, senior biochemist in charge. Fundamental studies are made of the biochemical relationships existing between plants, soil, and fertilizers in the field, laboratory, and greenhouse, including the testing of fertilizer ratios or formulas, the various nitrogen carriers, potash carriers, and phosphate carriers used in commercial fertilizers, such detrimental materials in fertilizers as borax, and such materials as radium, manganese, and other materials suggested or offered for sale from time to time for fertilizer purposes.

The office of cotton, rubber, and other tropical plants is directed by O. F. Cook, senior botanist in charge. The investigations include the acclimatization and adaptation in southern and southwestern United States of varieties of cotton, corn, and other crop plants of tropical origin, the breeding of superior varieties of cotton, and the improvement of cultural methods for boll-weevil conditions, and investigations of rubber-producing possibilities of the United States, Philippine Islands, West Indies, Canal Zone, and tropical America.

The office of fiber plants is directed by L. H. Dewey, botanist in charge. Experiments in hard-fiber production are carried on in the Philippine Islands, Porto Rico, and Canal Zone, with flax in Michigan and Oregon, and with hemp in Wisconsin and Kentucky.

The office of drug, poisonous, and oil plants is directed by W. W. Stockberger, senior physiologist in charge. Scientific studies are made of the methods of producing, drying, and preserving crude botanical drug crops which may be grown in this country. Where poisonous plants cause losses of livestock, suspected plants are collected and identified, descriptions are prepared and published as an aid to stockmen, and the physiologically active principles are identified and their distribution in the various parts of the plants determined. Essential-oil crops are introduced, as well as oil-seed crops which are a satisfactory supplement to linseed oil, and chemical examinations are made of the wastes

which result from packing or canning, to recover fixed oils.

The office of plant geography and physiology is directed by H. L. Shantz, senior physiologist in charge. The physiological processes in plants are investigated from the physical and chemical standpoint to furnish fundamental knowledge for work in breeding, increasing production, disease and frost resistance, and in handling and storage methods. Investigations of plant geography and crop distribution are made, and their relation to climatic and soil conditions and the important problems in plant production are studied from a geographic point of view.

The office of nematology is directed by N. A. Cobb, senior nematologist in charge. The investigations deal primarily with the study of minute eelworms or nemas, certain species of which infest the roots of important crop plants and seriously injure them, whereas others are found to be beneficial, destroying insects or other species of injurious nemas.

The seed laboratory is directed by E. Brown, senior botanist in charge. Samples of seeds submitted by farmers, seedsmen, and others, or purchased in the market, are tested to determine the proportion of pure seeds present, the kinds and proportion of weed seeds or adulterants present, and the germination of the pure seeds. Samples of all shipments of seeds subject to the Federal seed act are examined to determine whether or not they comply with the requirements of the act.

The office of cereal crops and diseases is directed by C. R. Ball, senior agronomist in charge. These investigations cover methods of production, improvement, and control of the diseases of cereal crops, and a cooperative campaign with the States for the eradication of the common barberry, an intermediate host of the wheat rust, in the wheat belt of the Middle West.

The office of tobacco and plant nutrition is directed by W. W. Garner, senior physiologist in charge. Tobacco investigations include all phases of growing, curing, and handling tobacco, with the exception of tobacco insects and their control. Plant nutrition investigations deal with the growth, development, and composition of plants as affected by the length of day, the influence of certain crops on other crops following in the rotation, the plant-food elements, and the relative plant-food requirements of crops commonly grown in rotation.

The office of alkali and drought-resistant crops is directed by T. H. Kearney, senior physiologist in charge. Investigations are conducted to ascertain the adaptability of various crop plants to alkali soils and to soils having a limited water content, to study the physiological effects of alkali and of drought upon the growth of plants, and to develop a type of long-staple cotton thoroughly adapted to irrigated land in Arizona and California.

The office of sugar plants is directed by E. W. Brandes, senior pathologist in charge. Investigations of sugar cane, sugar beets, and sorghos are under way, including breeding for the production of types better adapted to conditions in the United States, comparative studies of cultural practices, and disease-control experiments.

The office of botany is directed by F. V. Coville, senior botanist in charge. The identification of wild and cultivated plants, the domestication and improvement of the blueberry, and experiments in weed control are under way.

The office of dry-land agriculture is directed by E. C. Chilcott, senior agriculturist in charge. The problems of the agricultural development of the Great Plains area are investigated. They include depth and manner of plowing, tillage after plowing for preparation of seed bed, intertillage between rows during growth of rowed crops, and alternate cropping, especially in relation to the seasonal distribution of rainfall.

The office of western irrigation agriculture is directed by C. S. Scofield, senior agriculturist in charge. Agricultural conditions in the arid and semiarid regions of the western United States are investigated by field studies and experiments to determine the crops, rotations, and cropping methods best suited to successful farming and, in cooperation with the Reclamation Bureau of the Department of the Interior and the various State experiment stations interested, to work out methods of improving these conditions.

The office of horticulture is directed by L. C. Corbett, senior horticulturist in charge. The investigations include breeding, culture, and methods of utilization of fruits, nuts, vegetables, and ornamentals, as well as transportation and storage of these crops.

The office of gardens and grounds is directed by J. W. Byrnes, assistant in charge. A range of 32 greenhouses is maintained for the inspection and fumigation of plants, propagation and



general hybridization work, seed testing, and propagation of plants for ornamenting the grounds of the department and producing and growing a collection of hybrid amaryllis bulbs.

Arlington Experiment Farm is directed by E. C. Butterfield, horticulturist and superintendent in charge. Facilities are maintained for a suitable field laboratory for the investigational units of the department in Washington, including orchards, vineyards, experimental plots of ground, buildings, grain and forage for teams, animals and implements, roads, grounds and water supply.

The office of foreign plant introduction is directed by David Fairchild, senior agricultural explorer in charge. Foreign agricultural explorations are made for the purpose of assembling promising varieties of fruits, vegetables, or other plants for testing in different regions of the United States. After the new varieties are held under quarantine observation for a sufficient period they are distributed to cooperators, State experiment stations, and others able to carry on satisfactory tests.

The office of forage crops is directed by R. A. Oakley, senior agronomist in charge. Field studies are conducted and cooperative relations are maintained with nearly all of the State experiment stations and insular experiment stations, pertaining to the production and improvement of all crop plants used for forage either as hay, fodder, silage, or pasture, and incidentally of all plants used for green manuring, turf production, and soil binding. The distribution of new and rare field seeds, through cooperation with Members of Congress, to the various sections of the United States where the respective crops appear to offer promise has hastened the general use and popularity of soy beans, velvet beans, superior varieties of forage and grain sorghums, Sudan grass, and other grasses.

The biophysical laboratory is directed by G. N. Collins, senior botanist in charge. The physical laws involved in the growth and reproduction of plants are investigated, involving the response of agricultural plants to heat, light, moisture, electric currents, and the chemical composition of the soil.

#### PUBLICATIONS

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- Cold storage of Florida grapefruit. Fla. Grower 33(10): 16-17, 26.
- Citrus fruit growing in the Southwest. U. S. Dept. Agr. Farmers' Bul. 1447.
- A miracle of the desert. (Whitney grapefruit orchard in Coachella Valley.) Calif. Citrograph 11: 151, 160.
- Bud selection in the Washington Navel orange. Jour. Heredity 16: 233-241, 299-306, 367-374, 415-422, 449-455; 17: 59-65.
- Fermenting citron of commerce. U. S. Dept. Agr. Off. Rec. 5(4): 5.
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- Preliminary report on colloidal clays as emulsifiers for mineral oils used in spraying citrus groves. Jour. Agr. Research, 31: 59-65.
- Spraying for citrus melanose control. Citrus Indus. 7(3): 6-7, 31.
- Spraying for control of citrus melanose. Fla. Grower 33(11): 6, 29.
- Polycary, polypory, and polyploidy in citrus and citrus relatives. Jour. Wash. Acad. Sci. 15: 347-351.
- Relative susceptibility of some rutaceous plants to attack by the citrus-scab fungus. Jour. Agr. Research 30: 1087-1093.

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- Further studies on the overwintering of *Pseudomonas citri*. (With Ala. Agr. Exp. Sta.) Jour. Agr. Research 32: 335-345.
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- Partial thermotaxis of the growth center of the date palm. Jour. Agr. Research 31: 415-453.
- The inhibitive effect of direct sunlight on the growth of the date palm. Jour. Agr. Research 31: 455-468.
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- The avocado scab organism. Phytopathology 15: 807.
- A note on a rot of the Smyrna fig in California. Science 62: 288.
- An improved type of pressure tester for the determination of fruit maturity. U. S. Dept. Agr. Circ. 350.
- Deciduous fruit maturity investigations. Proc. Conv. Fruit Grow. and Farm. Month. Bul. Dept. Agr. Calif. 15: 63/74.
- The propagation of apple varieties by cuttings. Science 62: 544.
- The use of burr-knots in the vegetative propagation of apple varieties. Proc. Amer. Soc. Hort. Sci. 22: 228-230.



Burr-knot of apple trees. Its relation to crown gall and to vegetative propagation. Jour. Heredity 16: 313-320.

Stem-borne rudimentary roots of apple—frequently confused with crown gall. U. S. Dept. Agr. Off. Rec. 4(30): 5.

The relation of leaf area to the growth and composition of apples. Proc. Amer. Soc. Hort. Sci. 22: 189-196.

Some high-temperature effects in apples: Contrasts in the two sides of an apple. Jour. Agr. Research 32: 1-16.

Apple blotch. U. S. Dept. Agr. Farmers' Bul. 1479.

Apple cedar-rust control. Proc. Ann. Blister Rust Conf. 10: 29-34.

Apple scab. U. S. Dept. Agr. Farmers' Bul. 1478.

The variability in the black-rot fungus of the apple. Phytopathology 16: 41-46.

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Some effects of seasonal conditions upon the chemical composition of American grape juices. Jour. Agr. Research 30: 1133-1176.

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Starting a bramble plantation. Amer. Fruit Grow. Mag. 46 (4): 3, 33.

Anthraxose of dewberries and its control. North Carolina Agr. Exp. Sta. Bul. 248.

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Chromosomes and their significance in strawberry classification. Jour. Agr. Research 32: 559-568.

Essentials in strawberry culture. I. Amer. Fruit Grow. Mag. 46 (4): 9, 42.

Relation of strawberry fruit rots to weather conditions in the field. Phytopathology 16: 229-232.

Growth of Botrytis on strawberries under refrigeration. Ice and Refrigeration 69: 375-376.

The distribution of cranberry false blossom. Phytopathology 16: 223-227.

Comparative efficiency of wire-basket bunkers in refrigerator cars. U. S. Dept. Agr. Bul. 1398.

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## REPORT OF THE CHIEF OF THE BUREAU OF PUBLIC ROADS

UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF PUBLIC ROADS,  
Washington, D. C., October 15, 1926.

SIR: I have the honor to submit herewith the report of the Bureau of Public Roads for the fiscal year ended June 30, 1926, covering the work done in connection with the construction of Federal-aid and national forest roads and the economic and physical researches made in the highway field. A report of the work done by the agricultural engineering division of the bureau is submitted separately.

Respectfully,

THOS. H. MACDONALD,  
*Chief of Bureau.*

HON. W. M. JARDINE,  
*Secretary of Agriculture.*

### PROGRESS IN FEDERAL-AID ROAD CONSTRUCTION

The Federal-aid road projects completed during the fiscal year contributed a net addition of 9,417.3 miles to the mileage of improved roads in the Federal-aid highway system. Added to the mileage improved with Federal assistance in previous years, the above brings the total length of improved Federal-aid roads up to 55,902.8 miles.

At the close of the year construction was in progress on 10,961.8 miles and projects involving the improvement of 2,469.5 miles additional had been approved. Including the mileage of projects in these latter stages, all of which is included in the Federal-aid system, the total mileage improved or in process of improvement with Federal aid was 69,334.1 miles. With the exception of a few hundred miles improved prior to the designation of the Federal-aid highway system in 1921, all of this mileage is included in the system.

The highways included in the system now have an aggregate length of 182,134.8 miles. All have been selected by the constituted State and Federal highway officials as essential links of a system adequate for the accommodation of interstate traffic. Naturally there are degrees of importance even among these selected roads, but com-

pared with the 3,000,000 miles of other highways in the country they are the most important of the Nation's highways and their improvement is absolutely essential for the proper accommodation of interstate highway traffic.

It is entirely consistent with the interests of the Federal Government to participate in the improvement of every mile of the designated system, but that will not be necessary. With negligible exceptions the roads included in the Federal-aid system are also parts of the several State highway systems. This is inevitable from the fact that important interstate roads are almost invariably essential State arteries also; and because of its importance to the States a very considerable mileage included in the system had already been improved prior to its designation.

The net mileage requiring construction in order to complete the improvement of the system, has, therefore, always been considerably less than the mileage of the system, and the work of improvement has always been carried on by the States independently as well as in cooperation with the Federal Government. In fact, as shown in Table 1, the State reports indicate that the mileage independently improved is in excess of that improved with Federal assistance; so that it is probable that the mileage within the system at present initially improved or in process



of improvement is not far from three-quarters of the total.

It is, however, not the intention to imply that the work of improvement is three-quarters done. Much of the betterment that has been effected is merely the first step toward the improvement that will ultimately be required. Of the nearly 56,000 miles improved with Federal aid nearly 10,000 miles are unsurfaced, the improvement consisting merely of the proper grading and draining of the road bed. An additional large mileage is surfaced with sand-clay and gravel.

TABLE 1.—*Federal-aid mileage completed during the fiscal year 1926, including original and stage construction, compared with total mileage completed in 1925 by the State highway departments*

Group of States	Federal-aid mileage (original and stage construction) completed, fiscal year 1926	Mileage completed by State highway departments, 1925	Ratio of Federal aid to State program
	Miles	Miles	Per cent
New England.....	161.4	631.0	25.6
Middle Atlantic.....	785.7	1,687.4	46.6
South Atlantic.....	1,239.6	3,201.9	38.7
East North Central.....	836.8	4,321.1	19.4
West North Central.....	3,365.3	6,538.5	51.5
East South Central.....	1,046.6	1,113.5	94.0
West South Central.....	1,384.0	3,165.9	43.6
Mountain.....	1,300.6	1,483.1	87.6
Pacific.....	490.4	1,009.8	48.6
Total.....	10,610.4	23,152.2	45.9

As traffic is constantly increasing, these roads can not long be permitted to remain as they are, and there is a definite agreement between the State and Federal agencies that they will be further improved as traffic requires and funds for the purpose become available.

All such improvements have been made in conformity with the policy of stage construction under which the condition of the highways, where traffic permits, is gradually advanced to the ultimate state of improvement with high-class surfacing or pavement by successive stages. An exactly similar policy was followed by the builders of the railroads, whose first object was to "get the traffic through," leaving until a later date the perfecting processes of ballasting, banking of curves, etc. It is the only satisfactory

method of dealing with the conditions existing in many of the Southern, Middle Western, and Western States in which there are thousands of miles of main road still entirely devoid of any improvement whatever.

That the purpose to continue the improvement as required is being conscientiously fulfilled is indicated by the fact that during the fiscal year secondary stages of improvement were completed on 1,193 miles previously improved with Federal aid. This work, involving the construction of 886.7 miles of gravel surfacing, 195.7 miles of concrete pavements, and smaller mileages of several other types of surfacing, is not represented in the 9,417.3 miles reported as improved, all of which was original improvement, and does not add to the total of 55,902.8 miles improved up to the close of the year. From the standpoint of the year's work, however, it does represent an accomplishment; and it may, therefore, be said that the mileage improved during the year was actually 10,610.3 miles, which exceeds the performance of any previous year except the last when 11,328.6 miles of original construction were completed.

#### IMPROVEMENT OF TRANSCONTINENTAL ROADS APPROACHING COMPLETION

Ten years ago, when the Federal-aid plan was adopted, there were only five States in which there was a single improved trans-State highway. They were Massachusetts, Connecticut, New York, New Jersey, and Maryland, all Eastern States, and all of that small group in which the movement for better highways was begun in the nineties.

In 16 States there was then no State highway department nor the semblance of a plan for the development of through routes across the State; and even of those States in which a recently created State agency was feeling its way toward a more scientific and businesslike administration of State highways there were few in which the conception of a connected State highway system had yet been clearly apprehended.

To-day 25 States have continuously improved highways entirely across them in at least one direction and 16 of these have completed such trans-State arteries in two directions.

It is the primary purpose of the Federal-aid road legislation to expedite the continuous improvement of such cross-State highways in all States and finally to provide a completely articulated system of main interstate highways for the Nation. The goal, as

represented by the Federal-aid highway system, is clearly defined and progress toward it has proceeded for the last five years at least without deviation. That progress will be continued with a more pronounced single-ness of purpose in the future until it shall be possible to travel by highway without obstacle in any direction across all States and throughout the Nation.

There is now one transcontinental road which is 97 per cent improved. It extends from Washington through St. Louis, Texarkana, and El Paso to San Diego. Of its entire length 93 per cent is surfaced and 4 per cent is merely graded and drained; and of the surfaced portion more than half is improved with bituminous macadam or better and the remainder is gravel. From Washington to St. Louis there is no unimproved section and nearly 96 per cent is surfaced with bituminous macadam or some higher type of pavement. From St. Louis to Texarkana 2 per cent of the distance is unimproved and 63 per cent is improved with a gravel surface, the rest with superior types. From Texarkana to El Paso there are unimproved sections to the amount of 4 per cent of the distance, gravel surfaces 50 per cent, and bituminous macadam or better the rest of the way; and from El Paso to San Diego, with the exception of 6 per cent of the distance, the route is surfaced 60 per cent with gravel or equivalent and the remainder with pavements and surfaces of higher types.

This road from Washington to San Diego is more nearly completed than any other transcontinental route. Of its total length of 3,133 miles, 2,907 miles are surfaced and 131 miles are graded and drained, leaving only 95 miles without improvement.

Next in point of improvement is the route from Atlantic City, N. J., to Astoria, Oreg. Of its total length of 3,240 miles, one-eighth is still unimproved, nearly another eighth is graded and drained, and the rest is improved with some form of wearing surface. Of other east-and-west routes, that from Norfolk, Va., to Los Angeles is 68 per cent improved; and from Chicago to Los Angeles, partly by this same line, is 63 per cent improved. From Boston to Seattle through the northern tier of States the most direct through road is 73 per cent improved and 69 per cent surfaced either with permanent or temporary surfacing.

#### TYPES OF FEDERAL-AID ROADS

The 9,417.3 miles involved in the projects completed during the year consist of 2,161.3 miles of graded and

drained earth roads, 627.3 miles surfaced with sand-clay, 3,274.1 miles with gravel, 58.2 miles with water-bound macadam, 553.2 miles with bituminous macadam, 179.6 miles paved with bituminous concrete, 2,464.3 miles of Portland cement concrete, 78.1 miles of brick, and 21.3 miles of bridges more than 20 feet in span.

The earth, sand-clay, and gravel roads are mainly in the South and in the States west of the Mississippi. Of the 6,062.7 miles of these three types completed during the year only 187.4 miles are in the Northern and Eastern States. The small mileage of water-bound macadam is scattered among the States of all geographic groups except the Middle Atlantic, West North Central, and Pacific; and the several higher types of construction including bituminous macadam and better are found in all sections, forming the highest percentage of the total however in the Northern and Eastern States.

A similar sectional distribution of the several types of construction exists with respect to all highways constructed with Federal aid; and, as shown by Table 1, there is an appropriate relation between the types constructed in the various geographic sections and what may be termed the potential motor vehicle traffic as represented by the ratio of motor vehicle registration to mileage of the Federal-aid system in each section.

TABLE 2.—*Relation of potential motor vehicle traffic and types of Federal-aid roads completed to June 30, 1926*

Geographic division	Number of motor vehicles per mile of Federal-aid system <sup>1</sup>	Percentage of mileage of roads completed	
		Bituminous macadam and higher types	Water-bound macadam and lower types
Middle Atlantic...	343	98.5	1.5
New England.....	223	70.8	29.2
Pacific.....	193	35.2	64.8
East North Central...	187	70.3	29.7
South Atlantic.....	85	35.9	64.1
West South Central...	74	21.8	78.2
West North Central...	62	14.2	85.8
East South Central...	61	25.5	74.5
Mountain.....	32	9.5	90.5
All States....	109	31.4	68.6

<sup>1</sup> As registered in the several States during the calendar year 1925.

In Table 2 the several geographic divisions are arranged in the descending

order of the ratio of their motor vehicle registration to the mileage of the Federal-aid highway system in each; and it will be observed that with the exception of the Pacific and East South Central groups the several divisions would be rated in the same order on the basis of their percentage of mileage suitable for medium and heavy motor vehicle traffic.

In addition to the 9,417.3 miles of original construction completed during the year, stage construction was completed on 1,193 miles, all of which had been previously constructed to lower type with Federal aid. This secondary construction was divided by types as follows: Sand-clay, 7.8 miles; gravel, 886.7 miles; water-bound macadam, 6.8 miles; bituminous macadam, 46.3 miles; bituminous concrete, 49.5 miles; Portland cement concrete, 195.7 miles.

That this process of gradual improvement is being continued at a desirable rate is indicated by the fact that stage construction was in progress on 1,328.9 miles, including 943.6 miles of gravel, 75.3 miles of water-bound macadam, 36.5 miles of bituminous macadam, 44.9 miles of bituminous concrete, 227.8 miles of Portland cement concrete, and 0.8 miles of brick.

Both in mileage of stage construction completed and in mileage under construction the West North Central States led all other groups by a wide margin, the Mountain and South Atlantic States being next in order. No work of this character has been undertaken in the New England or Middle Atlantic States and only a relatively small mileage is in the East North Central States. From Table 1 it will be observed that these are the groups in which the original construction is predominantly of the highest character, and in which there is consequently the least need for further improvement.

In view of the general increase in motor-vehicle traffic throughout the country it is interesting to observe from Table 3 that the greatest increase in mileage was of those types, including the gravel, bituminous, and pavement

types, which are most suitable for motor-vehicle traffic.

TABLE 3.—*Mileage of Federal-aid highways at the close of the fiscal years 1925 and 1926 and percentage of increase*

Type	Mileage at close of fiscal year 1925	Mileage at close of fiscal year 1926	Percentage increase during fiscal year 1926
Graded and drained	9,079.2	9,653.7	6.3
Sand-clay	4,446.3	4,926.2	10.8
Gravel	18,013.8	22,514.3	25.1
Water-bound macadam	1,032.2	1,123.3	8.8
Bituminous macadam	2,564.2	3,176.3	23.8
Bituminous concrete	1,370.5	1,626.1	18.6
Portland cement concrete	9,234.6	11,976.6	29.8
Brick	644.2	752.0	16.8
Total	46,385.0	55,781.5	20.2

The types least suitable for motor-vehicle traffic are the graded and drained earth roads, and those surfaced with sand-clay and water-bound macadam; those preeminently adapted to such traffic are the bituminous types, concrete and brick. Although the new construction of the first groups amounted to 30.3 per cent of the total new mileage, the net addition of mileage of this character was only 12.2 per cent of the total net increase; the net increase of the types most suitable for motor traffic was 39.5 per cent, although the new mileage of these types constructed was only 34.9 per cent of the total new mileage. The gravel type, which is the cheapest type capable of resisting moderate motor-vehicle traffic and the usual choice for the secondary improvement of earth roads, increased 48.2 per cent in net mileage, although in the new construction it constituted only 34.9 per cent. These differences between the new construction and net increases of the several types reflect the beneficial results of the stage construction.



## TWENTY-ONE MILES OF BRIDGES COMPLETED

The 21.3 miles of bridges completed, while by no means comparable with the large completion during the preceding year, represent a very considerable addition to the list of important bridges constructed with Federal aid. Including the structures just completed the aggregate length of all completed bridges was 121.6 miles.

All of these structures are more than 20 feet in span, and four completed during the year are longer than a mile. These bridges, which are among the longest in the country, are the interstate bridge over the Savannah River

near Savannah, Ga., 1.6 miles in length; the bridge over the Missouri River near Lexington, Mo., 1.4 miles long; the bridge over the Raritan River at Perth Amboy, N. J., 1.6 miles long; and the Lake Champlain bridge near Milton, Vt., which is 1.2 miles in length.

A list of the bridges completed during the year which cost \$75,000 or more is given in Table 4. These, the longest structures completed, vary in length from a tenth of a mile to more than 1½ miles, and have an aggregate length of 12.7 miles, more than half of the mileage completed. The remainder is made up of numerous smaller and less expensive structures.

TABLE 4.—Federal-aid bridges completed during the fiscal year 1926 at a cost of \$75,000 or more each

State	Location	Stream	Length
			<i>Miles</i>
Alabama	Between Demopolis and Livingston	Tombigbee River	0.5
Do.	Between Florence and Huntsville	Shoal Creek	.2
California	Between Rio Dell and Fortuna	Van Duzen River	.2
Georgia (interstate)	Between Augusta, Ga., and Ellenton, S. C.	Savannah River	.1
Do.	Between Savannah, Ga., and Ridgeland, S. C.	do.	1.6
Georgia	Between Atlanta and Alpharetta	Chattahoochee River	.2
Mississippi	Between Jackson and Forest	Pearl River	.3
Missouri	At Glasgow	Missouri River	.4
Do.	Between Waverly and Carrollton	do.	.4
Do.	At Lexington	do.	1.4
Nebraska	Between Broadwater and Bridgeport	Platte River	.5
New Jersey	At Perth Amboy	Raritan River	1.6
Do.	At Point Pleasant	Manasquan River	.6
North Carolina	At Winton	Chowan River	.1
Oklahoma	Between Cleveland and Hominy	Arkansas River	.3
South Carolina	At Georgetown	Black River	.5
Do.	Between Greenwood and Mountville	Saluda River	.2
South Dakota	At Chamberlain	Missouri River	.3
Tennessee	At Clarksville	Cumberland River	.7
Do.	Between McMinville and Sparta	Caney Fork River	.1
Texas	At Richmond	Brazos River	.4
Utah	At Riverdale	Weber River	.5
Vermont	Between Milton and South Hero	Lake Champlain	1.2
Washington	At La Center	East Fork Lewis River	.2
Do.	Between Ferndale and Bellingham	Nooksack River	.2
Total			12.7

Reference has been made in previous annual reports to the exceptional benefit of Federal aid in the construction of these bridges, especially the longer ones. The spanning of a wide stream is an expensive undertaking and calls for the concentration at one point of a sum of money which represents often a considerable part of the State highway revenues available during the period required for its construction. Consequently the construction of such bridges is put off sometimes indefinitely. Yet their very size gives them a position of commanding importance in the highway system. Necessarily the number of crossings of wide streams must be very few. If built, therefore, a bridge over such a stream carries a traffic which con-

verges upon it from scores, perhaps hundreds of miles upstream and down, and if its construction is delayed traffic on a main State and interstate line of travel may be diverted a hundred miles or more out of the direct course. Faced with this alternative it is easy for the State to contemplate the issuance of a franchise for the construction of a toll bridge and thus avoid the necessary outlay of capital and put the burden upon the users of the bridge—a burden which includes a profit for a private corporation and which must still be borne in most instances long after the investment has been repaid by earnings.

From the Federal point of view the matter is of vital interest because, as stated above, these large structures are

focal points of traffic and almost invariably are controlling points on interstate routes. If the people of a single State are willing to pay toll for the use of a necessary bridge within their borders they have it in their control to deal with the matter in that way. But when the bridge in question lies upon an important interstate route and is used regularly by citizens of an adjacent State which has perhaps built similar bridges at public expense which are used freely by the citizens of the first State, an interstate question of a new order is raised. Such a case is now the subject of controversy between two of the States; and there may be many others in the future.

There would seem to be no more appropriate use of the Federal-aid appropriations than that which is presented by such structures—distinctly of interstate significance whether they lie at the border or in the interior of a State. It is possible, under the law, for the Federal Government to pay a full 50 per cent of the cost without regard to the amount so long as it is within the State's apportionment. By accepting the Federal assistance the State relieves its budget of half the total cost and the remainder, if financed with State bonds, will entail a smaller burden upon the citizens of the State than the tolls they would otherwise pay to a bridge building corporation. It is to be hoped, therefore, that as many as possible of such important bridges may be built in this way in the future; and in this connection it is gratifying to report that arrangements have now been made to finance in this way what is perhaps one of the four or five most important bridges in the country—the bridge over the Mississippi at Memphis.

#### FEDERAL AID DOES NOT CAUSE EXTRA- GANT STATE EXPENDITURE

The total cost of the 9,417.3 miles of original construction and the 1,193 miles of stage construction completed during the year was \$206,139,220.27, of which 90,294,106.76 was paid by the Federal Government. These expenditures were made over the period required to bring the above mileage to completion, approximately two years, and during the same period additional expenditures were made upon other projects under construction.

The actual disbursement of Federal-aid funds was \$87,754,534.57, as shown by States in Table 5. This is a reduction of approximately \$8,000,000 below the disbursement of the preceding

year, and further reduction may be expected in the future as accumulated balances are expended and the program of expenditure reaches the rate set by the annual authorization of \$75,000,000 of the recent past and immediate future.

TABLE 5.—*Federal-aid disbursements to States, fiscal year 1926*

State	Federal-aid disbursement
Alabama.....	\$1,966,619.02
Arizona.....	558,251.42
Arkansas.....	1,710,136.62
California.....	3,287,067.83
Colorado.....	1,468,873.84
Connecticut.....	179,493.71
Delaware.....	317,922.17
Florida.....	836,169.33
Georgia.....	2,546,473.57
Idaho.....	1,211,467.29
Illinois.....	2,061,553.20
Indiana.....	2,998,195.55
Iowa.....	1,179,173.37
Kansas.....	2,010,983.12
Kentucky.....	1,629,262.22
Louisiana.....	738,714.02
Maine.....	428,522.80
Maryland.....	982,038.88
Massachusetts.....	1,053,331.47
Michigan.....	2,798,228.48
Minnesota.....	2,294,445.91
Mississippi.....	1,554,835.58
Missouri.....	4,015,329.79
Montana.....	659,904.88
Nebraska.....	1,863,988.89
Nevada.....	1,453,240.19
New Hampshire.....	298,143.45
New Jersey.....	2,087,825.66
New Mexico.....	1,020,042.23
New York.....	4,664,644.52
North Carolina.....	3,082,882.17
North Dakota.....	925,094.42
Ohio.....	2,472,310.12
Oklahoma.....	2,887,622.14
Oregon.....	1,656,072.98
Pennsylvania.....	5,772,232.58
Rhode Island.....	285,490.94
South Carolina.....	1,810,458.38
South Dakota.....	1,828,659.29
Tennessee.....	2,364,696.15
Texas.....	5,284,156.01
Utah.....	1,081,703.45
Vermont.....	415,055.81
Virginia.....	2,514,371.36
Washington.....	1,430,361.90
West Virginia.....	1,096,945.39
Wisconsin.....	1,700,875.89
Wyoming.....	1,212,767.42
Hawaii.....	57,899.37
Total.....	87,754,534.57

As the annual highway expenditure of the country is in excess of a billion dollars, the Federal expenditure is not over 8 per cent of the total. And the fact that the percentage of interstate traffic on the roads of practically all States equals or exceeds that figure is evidence that, from the Federal point of view, the current rate of expenditure is not excessive, aside from all consideration of the general Federal

and interstate benefits derived from the resulting improvements. But the Federal-aid road work is a cooperative undertaking on the part of the Federal and State Governments in which the States are required to match in certain proportions the expenditures of the Federal Government. It is proper, therefore, to inquire whether in thus matching the contributions of the Government the States are induced to make expenditures for road improvement greater than they would make if the Federal aid were not offered.

That this is not the case is evidenced by the fact, as shown in Table 6, that in 1925 every State, without exception, made expenditures for road improvement in addition to those made for the Federal-aid roads, the total of such expenditures being \$438,544,000, or approximately four times the amount spent to match the Federal aid. These are State expenditures only. They do not include the amounts spent by the counties independent of State control which, doubtless, equaled or exceeded those of the States.

TABLE 6.—*Approximate disbursements by State highway departments in excess of expenditures for Federal-aid roads, calendar year 1925*

State	State disbursements for other than Federal-aid roads	State	State disbursements for other than Federal-aid roads
Alabama.....	\$6,917,000	Nebraska.....	\$1,964,000
Arizona.....	1,263,000	Nevada.....	936,000
Arkansas.....	7,140,000	New Hampshire.....	3,227,000
California.....	11,891,000	New Jersey.....	15,540,000
Colorado.....	1,797,000	New Mexico.....	223,000
Connecticut.....	7,252,000	New York.....	33,869,000
Delaware.....	2,703,000	North Carolina.....	24,088,000
Florida.....	6,234,000	North Dakota.....	143,000
Georgia.....	2,502,000	Ohio.....	16,386,000
Idaho.....	1,857,000	Oklahoma.....	6,138,000
Illinois.....	30,676,000	Oregon.....	13,153,000
Indiana.....	8,718,000	Pennsylvania.....	44,294,000
Iowa.....	11,608,000	Rhode Island.....	2,326,000
Kansas.....	836,000	South Carolina.....	5,633,000
Kentucky.....	10,667,000	South Dakota.....	2,871,000
Louisiana.....	6,870,000	Tennessee.....	9,129,000
Maine.....	6,465,000	Texas.....	6,585,000
Maryland.....	10,485,000	Utah.....	2,374,000
Massachusetts.....	8,935,000	Vermont.....	2,678,000
Michigan.....	30,038,000	Virginia.....	8,172,000
Minnesota.....	13,062,000	Washington.....	5,446,000
Mississippi.....	1,265,000	West Virginia.....	14,059,000
Missouri.....	23,084,000	Wisconsin.....	4,885,000
Montana.....	357,000	Wyoming.....	1,803,000

There is no ground for belief that the effort to meet the Federal contribution is burdensome to the taxpayers of the States. The State funds required to match a Federal appropriation of \$75,000,000 a year in the proportions required by the Federal law amount to \$67,081,920. As shown by Table 7, the gross income of the States from motor vehicle license fees and gasoline taxes amounted in the calendar year 1925 to \$405,467,756, a sum sufficient to match the Federal aid six times over, almost large enough, indeed, to cover

the entire annual expenditure of the State highway departments; and the amount of this income from the motor vehicle is still increasing with the phenomenal growth of registration. These special taxes are paid by owners of motor vehicles, not grudgingly, but with entire willingness so long as they are used for road improvement, because it is generally recognized that the return in the form of reduced operating expense and improved highway service more than compensates the tax.

Table 7 follows.



TABLE 7.—*Comparison of State motor-vehicle revenues and funds required to match Federal appropriations*

State	State funds required to match Federal appropriation of \$75,000,000	Gross income from motor-vehicle license fees and gasoline taxes, calendar year 1925
Alabama.....	\$1,541,870	\$4,651,931
Arizona <sup>1</sup> .....	403,800	1,261,543
Arkansas.....	1,264,164	6,100,360
California <sup>1</sup> .....	1,628,000	22,773,087
Colorado <sup>1</sup> .....	1,068,000	3,391,245
Connecticut.....	474,801	7,553,056
Delaware.....	365,625	1,022,781
Florida.....	892,878	11,303,135
Georgia.....	1,983,089	7,429,239
Idaho <sup>1</sup> .....	628,000	2,088,030
Illinois <sup>2</sup> .....	3,191,479	12,969,754
Indiana.....	1,938,693	12,302,712
Iowa.....	2,070,396	13,246,218
Kansas.....	2,074,360	7,515,284
Kentucky.....	1,411,607	6,821,622
Louisiana.....	997,262	5,739,588
Maine.....	685,140	3,450,483
Maryland.....	635,783	4,553,337
Massachusetts <sup>2</sup> .....	1,090,118	9,843,901
Michigan.....	2,225,227	22,762,080
Minnesota.....	2,124,151	13,608,774
Mississippi.....	1,291,960	4,024,274
Missouri.....	2,417,727	11,426,213
Montana <sup>1</sup> .....	1,193,000	1,589,963
Nebraska.....	1,581,969	6,130,260
Nevada <sup>1</sup> .....	132,000	527,902
New Hampshire.....	365,625	2,443,166
New Jersey <sup>2</sup> .....	935,082	10,515,323
New Mexico <sup>1</sup> .....	690,000	995,230
New York <sup>2</sup> .....	3,657,096	25,506,245
North Carolina.....	1,699,163	14,442,222
North Dakota.....	1,180,699	1,717,989
Ohio.....	2,789,588	22,157,181
Oklahoma <sup>1</sup> .....	1,415,000	9,720,089
Oregon <sup>1</sup> .....	710,000	8,279,297
Pennsylvania.....	3,360,123	30,279,770
Rhode Island.....	365,625	2,182,312
South Carolina.....	1,052,549	6,231,479
South Dakota <sup>1</sup> .....	965,000	4,292,710
Tennessee.....	1,622,985	6,468,834
Texas.....	4,415,715	18,119,715
Utah <sup>1</sup> .....	229,000	1,618,239
Vermont.....	365,625	1,999,418
Virginia.....	1,449,713	8,002,901
Washington <sup>1</sup> .....	941,000	8,000,838
West Virginia.....	797,295	5,540,986
Wisconsin.....	1,873,308	11,927,886
Wyoming <sup>1</sup> .....	525,000	939,154
Hawaii <sup>3</sup> .....	365,625	-----
Total.....	67,081,920	405,467,756

<sup>1</sup> States not on 50-50 basis on account of public lands and nontaxable Indian lands.

<sup>2</sup> No gasoline tax assessed.

<sup>3</sup> No tax data available.

As shown by the foregoing facts there is no reason to believe that the necessity of matching Federal aid has caused the States to incur a large bonded indebtedness. Twenty-four of the States have issued no bonds for highway purposes since Federal aid was initiated. The other 24 have incurred a total indebtedness of \$604,410,600. In 13 of these the amount of the bonds issued has con-

siderably exceeded the total of their Federal-aid apportionments, and can not, therefore, have been required to match the Federal contributions. Of the remaining 11 States, 3—Massachusetts, New York, and Rhode Island—are States of large resources, and it is not conceivable that they have needed to issue bonds to match the Federal aid. Two others—Louisiana and Nevada—have a negligible total indebtedness. The remaining 6 States are Colorado, Idaho, New Mexico, South Dakota, Utah, and Wyoming; and it is conceivable that their bond issues may have been necessary to provide funds with which to match the Federal aid offered to them; but their combined issues during the 10-year period amount to only \$31,800,000, and they have received almost double that amount from the Federal Government.

#### FEDERAL-AID APPORTIONMENT CONSISTENT WITH TRAFFIC DEMAND

The Federal-aid appropriations are apportioned in accordance with a method prescribed by the law on the basis of the relative area and population of the several States and their total mileage of rural post roads and star routes. Although the method is somewhat arbitrary, it has been shown repeatedly to produce a result which is fairly consistent with the basic wealth and production of the several States. As these are the factors which, fundamentally, are the measures both of the need for highway improvement and the capacity to pay for it, there can be no reasonable doubt of the essential fairness of the distribution.

Viewed specifically from the standpoint of the traffic demand of the several groups of States, Table 8 shows that the apportionment per mile of the Federal-aid system to date is reasonably consistent with the traffic requirements as measured by the motor-vehicle registration per mile of the system. The largest potential traffic, i. e., the largest motor-vehicle registration per mile, is in the Middle Atlantic States, and this group of States, including New York, Pennsylvania, and New Jersey, is also shown to have received the largest apportionment of Federal aid in proportion to the mileage of the Federal-aid system within their borders. Next in order of potential traffic and also in the magnitude of the apportionment are the New England States; and a similarly consistent relation exists with respect to all other groups, with the exception of the East South Central and Mountain States, which are shown

to have received a somewhat disproportionate apportionment considered from the point of view of their potential traffic. The order of the several groups of States in Table 8 is very similar to their relative ranking

on the basis of the mileage of high-type Federal-aid road construction as shown in Table 2, thus indicating that the Federal appropriations are being expended in a manner consistent with the requirements of the traffic.

TABLE 8.—Apportionment of Federal aid per mile of Federal-aid highway system compared with motor-vehicle registration

Group of States	Mileage of Federal-aid system approved to June 30, 1926	Federal-aid funds apportioned to States June 11, 1916, to June 30, 1926	Motor vehicles registered during 1925	Average Federal-aid apportionment per mile of system	Motor-vehicle registration per mile of system
	<i>Miles</i>				
Middle Atlantic.....	10,306.8	\$73,851,396	3,536,570	\$7,165	343
New England.....	5,799.7	30,012,803	1,290,151	5,175	223
East North Central.....	26,310.1	111,549,529	4,918,383	4,240	187
Pacific.....	10,296.1	43,097,938	1,985,536	4,186	193
East South Central.....	14,429.8	54,970,873	878,115	3,810	61
South Atlantic.....	21,429.3	81,288,777	1,817,890	3,793	85
Mountain.....	21,615.3	80,080,227	692,779	3,705	32
West South Central.....	24,328.0	77,544,430	1,790,017	3,187	74
West North Central.....	47,619.7	117,878,874	2,941,814	2,475	62
All States.....	182,134.8	1,670,274,847	19,851,255	3,680	109

<sup>1</sup> Including the apportionment of \$1,100,153 to Hawaii the total apportionment up to June 30, 1926, was \$671,375,000.

#### SUMMARY OF FEDERAL-AID ROAD WORK BY STATES

The progress made in each of the States during the year and the results of the 10 years of Federal-aid road construction are set forth in the following condensed summary for each State.

##### ALABAMA

The Federal-aid highway system in Alabama includes 3,872 miles, of which 1,415.7 miles have been improved with Federal aid. Of the improved mileage, 262 miles were added during the year, and 89.9 miles were under construction.

The mileage improved with Federal aid consists of 28.3 miles of graded and drained earth roads, 417.5 miles of sand-clay, 768.6 miles of gravel, 6 miles of water-bound macadam, 58.8 miles of bituminous macadam, 80.8 miles of bituminous concrete, and 52.9 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.8 miles.

The total cost of the roads completed during the year was \$4,288,712.99, of which the Federal share was \$1,831,731.14. The disbursement of Federal funds to the State was \$1,966,619.02. This added to the disbursements made during previous years and subtracted from the State's total apportionment of

\$14,349,455, leaves a balance of \$4,430,-272.52 of unexpended funds to the credit of the State.

##### ARIZONA

The Federal-aid highway system includes 1,498 miles, of which 767.1 miles have been improved with Federal aid. Of the improved mileage 96.6 miles were added during the year. At the close of the year 44.1 miles were under construction and 12.2 miles were approved but not yet under construction.

The mileage improved with Federal aid consists of 92.4 miles of graded and drained earth roads, 122.3 miles of sand-clay, 404.8 miles of gravel, 14.2 miles of water-bound macadam, 22.7 miles of bituminous concrete, and 108.6 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.2 miles.

The total cost of the roads completed was \$1,378,605.07, of which the Federal share was \$885,678.50. The disbursement of Federal funds to the State was \$558,251.42. This added to the disbursements made during previous years and subtracted from the State's total apportionment of \$9,617,249, leaves a balance of \$3,358,108.81 of unexpended funds to the credit of the State.



**ARKANSAS**

The Federal-aid highway system includes 5,007 miles, of which 1,418.5 miles have been improved with Federal aid. Of the improved mileage 281.6 miles were added during the year. At the close of the year 213.3 miles were under construction and 31.1 miles were approved.

The mileage improved with Federal aid consists of 3.1 miles of sand-clay, 919.2 miles of gravel, 48.2 miles of water-bound macadam, 84.1 miles of bituminous macadam, 248.4 miles of bituminous concrete, and 114.1 miles of Portland cement concrete, in addition to which there are bridges with a total length of 1.6 miles.

The total cost of the roads completed was \$4,375,795.99, of which the Federal share was \$2,317,678.87. The disbursement of Federal funds to the State was \$1,710,136.62. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$11,605,804, leaves a balance of \$2,503,265.69 of unexpended funds to the credit of the State.

**CALIFORNIA**

The Federal-aid highway system includes 4,574.4 miles, of which 1,169.7 miles have been improved with Federal aid. Of the improved mileage, 222.8 miles were added during the year. At the close of the year 208.2 miles were under construction and 18.2 miles were approved.

The mileage improved with Federal aid consists of 276.9 miles of graded and drained earth roads, 280.4 miles of gravel, 18.1 miles of water-bound macadam, 55.5 miles of bituminous macadam, 67.3 miles of bituminous concrete, and 468.9 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.6 miles.

The total cost of the roads completed, including 7.1 miles of stage construction, was \$5,727,131.79, of which the Federal share was \$2,752,692.79. The disbursement of Federal funds to the State was \$3,287,067.83. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$22,072,815, leaves a balance of \$5,952,659.70 of unexpended funds to the credit of the State.

**COLORADO**

The Federal-aid highway system includes 3,332 miles, of which 797 miles have been improved with Federal aid. Of the improved mileage, 84.5 miles

were added during the year. At the close of the year 162.5 miles were under construction and 21.8 miles were approved.

The mileage improved with Federal aid consists of 172.5 miles of graded and drained earth roads, 76.8 miles of sand-clay, 352.7 miles of gravel, 5.9 miles of bituminous concrete, and 184.7 miles of Portland cement concrete, in addition to which there are bridges with a total length of 4.4 miles.

The total cost of the roads completed, including 1.9 miles of stage construction, was \$1,923,572.30, of which the Federal share was \$966,142.48. The disbursement of Federal funds to the State was \$1,468,873.84. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$12,325,812, leaves a balance of \$4,196,323.82 of unexpended funds to the credit of the State.

**CONNECTICUT**

The Federal-aid highway system includes 835.4 miles, of which 127.1 miles have been improved with Federal aid. Of the improved mileage 8.7 miles were added during the year. At the close of the year 38 miles were under construction and 9.9 miles were approved.

The mileage improved with Federal aid consists of 8.8 miles of water-bound macadam, 27 miles of bituminous macadam, and 91.3 miles of Portland cement concrete.

The total cost of the roads completed was \$395,689.66, of which the Federal share was \$136,570. The disbursement of Federal funds to the State was \$179,493.71. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$4,333,681, leaves a balance of \$1,980,818.25 of unexpended funds to the credit of the State.

**DELAWARE**

The Federal-aid highway system includes 385.2 miles, of which 124.3 miles have been improved with Federal aid. Of the improved mileage 8.6 miles were added during the year. At the close of the year 28.2 miles were under construction and 15.7 miles were approved.

The mileage improved with Federal aid consists of 117.9 miles of Portland cement concrete and 6.2 miles of brick, in addition to which there are bridges with a total length of 0.2 mile.

The total cost of the roads completed was \$269,509.49, of which the Federal share was \$127,843.85. The disbursement of Federal funds to the State was



\$317,922.17. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$2,474,058, leaves a balance of \$556,979.74 of unexpended funds to the credit of the State.

#### FLORIDA

The Federal-aid highway system includes 1,926 miles, of which 249.7 miles have been improved with Federal aid. Of the improved mileage 36.9 miles were added during the year. At the close of the year 162.9 miles were under construction.

The mileage improved with Federal aid consists of 11.8 miles of graded and drained earth roads, 34.1 miles of sand-clay, 13.6 miles of water-bound macadam, 72.6 miles of bituminous macadam, 23.3 miles of bituminous concrete, 81.7 miles of Portland cement concrete, and 10.1 miles of brick, in addition to which there are bridges with a total length of 2.6 miles.

The total cost of the roads completed was \$1,700,890.98, of which the Federal share was \$818,937.01. The disbursement of Federal funds to the State was \$836,169.33. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$8,084,954, leaves a balance of \$3,235,949.42 unexpended funds to the credit of the State.

#### GEORGIA

The Federal-aid highway system includes 5,558.4 miles, of which 1,975.5 miles have been improved with Federal aid. Of the improved mileage 322.7 miles were added during the year. At the close of the year 475.4 miles were under construction and 28.3 miles were approved.

The mileage improved with Federal aid consists of 96.2 miles of graded and drained earth roads, 1,194.9 miles of sand-clay, 345.7 miles of gravel, 41.7 miles of water-bound macadam, 95.9 miles of bituminous macadam, 15.9 miles of bituminous concrete, 161.9 miles of Portland cement concrete, and 0.5 mile of brick, in addition to which there are bridges with a total length of 23.1 miles.

The total cost of the roads completed, including 20.4 miles of stage construction, was \$5,141,532.68, of which the Federal share was \$2,504,419.51. The disbursement of Federal funds to the State was \$2,546,473.57. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$18,431,953, leaves a balance of \$2,991,838.09 unexpended funds to the credit of the State.

#### IDAHO

The Federal-aid highway system includes 2,768.6 miles, of which 773.7 miles have been improved with Federal aid. Of the improved mileage 133.8 miles were added during the year. At the close of the year 113.5 miles were under construction and 72.5 miles were approved.

The mileage improved with Federal aid consists of 165.6 miles of graded and drained earth roads, 18.6 miles of sand-clay, 514 miles of gravel, 4.3 miles of water-bound macadam, 37.6 miles of bituminous concrete, and 32.8 miles of Portland cement concrete, in addition to which there are bridges with a total length of 1.1 miles.

The total cost of the roads completed, including 36 miles of stage construction, was \$2,081,356.55, of which the Federal share was \$1,320,858.71. The disbursement of Federal funds to the State was \$1,211,467.29. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$8,559,627, leaves a balance of \$1,870,582.13 of unexpended funds to the credit of the State.

#### ILLINOIS

The Federal-aid highway system includes 5,002.2 miles, of which 1,467.1 miles have been improved with Federal aid. Of the improved mileage 182.4 miles were added during the year. At the close of the year 124.4 miles were under construction and 24 miles were approved.

The mileage improved with Federal aid consists of 112.3 miles of graded and drained earth roads, 3.3 miles of bituminous macadam, 8.1 miles of bituminous concrete, 1,315.9 miles of Portland cement concrete, and 25.8 miles of brick, in addition to which there are bridges with a total length of 1.4 miles.

The total cost of the roads completed, including 0.6 mile of stage construction, was \$5,177,738.18, of which the Federal share was \$2,532,879.71. The disbursement of Federal funds to the State was \$2,061,553.20. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$29,832,198, leaves a balance of \$7,285,381.97 of unexpended funds to the credit of the State.

#### INDIANA

The Federal-aid highway system includes 4,679 miles, of which 687.2 miles have been improved with Federal aid. Of the improved mileage 157.2 miles were added during the year. At

the close of the year 275.1 miles were under construction and 51.7 miles were approved.

The mileage improved with Federal aid consists of 25.6 miles of graded and drained earth roads, 33.5 miles of gravel, 17 miles of bituminous macadam, 12 miles of bituminous concrete, and 597.6 miles of Portland cement concrete, in addition to which there are bridges with a total length of 1.6 miles.

The total cost of the roads completed was \$5,432,841.65, of which the Federal share was \$2,584,668.72. The disbursement of Federal funds to the State was \$2,998,195.55. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$18,204,355, leaves a balance of \$4,699,325.92 of unexpended funds to the credit of the State.

#### IOWA

The Federal-aid highway system includes 7,212 miles, of which 2,177 miles have been improved with Federal aid. Of the improved mileage 138.6 miles were added during the year. At the close of the year 586.7 miles were under construction and 146.8 miles were approved.

The mileage improved with Federal aid consists of 1,303.4 miles of graded and drained earth roads, 425.5 miles of gravel, 425.9 miles of Portland cement concrete, and 22 miles of brick, in addition to which there are bridges with a total length of 0.3 mile.

The total cost of the roads completed, including 12.4 miles of stage construction, was \$2,589,254.14, of which the Federal share was \$1,170,140.16. The disbursement of Federal funds to the State was \$1,179,173.37. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$19,485,563, leaves a balance of \$5,683,720.65 of unexpended funds to the credit of the State.

#### KANSAS

The Federal-aid highway system includes 7,892 miles, of which 1,263.6 miles have been improved with Federal aid. Of the improved mileage 269.1 miles were added during the year. At the close of the year 548.9 miles were under construction and 129.9 miles were approved.

The mileage improved with Federal aid consists of 313 miles of graded and drained earth roads, 112.2 miles of sand-clay, 180.8 miles of gravel, 4.5 miles of water-bound macadam, 84.6 miles of bituminous macadam, 3.5 miles of bituminous concrete, 439.2 miles of Portland cement concrete, and 123 miles

of brick, in addition to which there are bridges with a total length of 2.5 miles.

The total cost of the roads completed, including 19.6 miles of stage construction, was \$4,023,851.60, of which the Federal share was \$2,034,853.94. The disbursement of Federal funds to the State was \$2,010,983.12. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$19,464,411, leaves a balance \$4,791,623.07 of unexpended funds to the credit of the State.

#### KENTUCKY

The Federal-aid highway system includes 3,701 miles, of which 787.4 miles have been improved with Federal aid. Of the improved mileage 188.8 miles were added during the year. At the close of the year 250.9 miles were under construction and 3.6 miles were approved.

The mileage improved with Federal aid consists of 388.9 miles of graded and drained earth roads, 118.9 miles of gravel, 41.4 miles of water-bound macadam, 139.8 miles of bituminous macadam, 94.5 miles of Portland cement concrete, and 3.9 miles of brick, in addition to which there are bridges with a total length of 0.2 mile.

The total cost of the roads completed, including 34 miles of stage construction, was \$5,919,328.90, of which the Federal share was \$2,252,781.48. The disbursement of Federal funds to the State was \$1,629,262.22. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$13,212,809, leaves a balance of \$3,302,647.39 of unexpended funds to the credit of the State.

#### LOUISIANA

The Federal-aid highway system includes 2,664 miles, of which 1,069.8 miles have been improved with Federal aid. Of the improved mileage 44.3 miles were added during the year. At the close of the year 147.4 miles were under construction and 29.8 miles were approved.

The mileage improved with Federal aid consists of 3.4 miles of graded and drained earth roads, 1,037.1 miles of gravel, 3.2 miles of water-bound macadam, 9.5 miles of bituminous macadam, 10.4 miles of bituminous concrete, and 3.6 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.8 miles.

The total cost of the roads completed was \$908,749.55, of which the Federal



share was \$362,623.35. The disbursement of Federal funds to the State was \$738,714.02. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$9,272,408, leaves a balance of \$2,238,441.66 of unexpended funds to the credit of the State.

#### MAINE

The Federal-aid highway system includes 1,393.5 miles, of which 303.6 miles have been improved with Federal aid. Of the improved mileage 15.6 miles were added during the year. At the close of the year 67.3 miles were under construction and 45.6 miles were approved.

The mileage improved with Federal aid consists of 126.7 miles of gravel, 137.4 miles of bituminous macadam, and 39.3 miles of Portland cement concrete, in addition to which there are bridges with a total length of 0.2 mile.

The total cost of the roads completed was \$388,599.74, of which the Federal share was \$192,580.02. The disbursement of Federal funds to the State was \$428,522.80. This, added to the disbursement made during previous years and subtracted from the State's total apportionment of \$6,464,828, leaves a balance of \$1,958,707.32 of unexpended funds to the credit of the State.

#### MARYLAND

The Federal-aid highway system includes 1,479.2 miles, of which 423.3 miles have been improved with Federal aid. Of the improved mileage 103.3 miles were added during the year. At the close of the year 30.7 miles were under construction and 57.7 miles were approved.

The mileage improved with Federal aid consists of 4.7 miles of graded and drained earth roads, 31.5 miles of gravel, 0.1 mile of water-bound macadam, 106.9 miles of bituminous macadam, 12.3 miles of bituminous concrete, and 268 miles of Portland cement concrete.

The total cost of the roads completed was \$1,985,590.44, of which the Federal share was \$901,945.32. The disbursement of Federal funds to the State was \$932,038.88. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$5,925,057, leaves a balance of \$778,960.03 of unexpended funds to the credit of the State.

#### MASSACHUSETTS

The Federal-aid highway system includes 1,308 miles, of which 385.7 miles have been improved with Federal aid.

Of the improved mileage 56.8 miles were added during the year. At the close of the year 35.4 miles were under construction and 21.1 miles were approved.

The mileage improved with Federal aid consists of 3.3 miles of water-bound macadam, 199.2 miles of bituminous macadam, 36.8 miles of bituminous concrete, and 143.9 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.5 miles.

The total cost of the roads completed was \$3,717,850.99, of which the Federal share was 932,863.07. The disbursement of Federal funds to the State was \$1,053,331.47. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$10,108,726, leaves a balance of \$3,314,597.38 of unexpended funds to the credit of the State.

#### MICHIGAN

The Federal-aid highway system includes 5,235 miles, of which 995.8 miles have been improved with Federal aid. Of the improved mileage 134.1 miles were added during the year. At the close of the year 213.7 miles were under construction and 11.6 miles were approved.

The mileage improved with Federal aid consists of 29.2 miles of graded and drained earth roads, 316.1 miles of gravel, 18.9 miles of water-bound macadam, 10.4 miles of bituminous macadam, 73.4 miles of bituminous concrete, 547.4 miles of Portland cement concrete, and 0.4 mile of brick.

The total cost of the roads completed, including 3.9 miles of stage construction, was \$4,599,169.26, of which the Federal share was \$1,985,509.96. The disbursement of Federal funds to the State was \$2,798,228.48. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$20,342,365, leaves a balance of \$5,679,010.31 of unexpended funds to the credit of the State.

#### MINNESOTA

The Federal-aid highway system includes 6,849.6 miles, of which 3,249.2 miles have been improved with Federal aid. Of the improved mileage 528 miles were added during the year. At the close of the year 524 miles were under construction and 11.1 miles were approved.

The mileage improved with Federal aid consists of 379 miles of graded and drained earth roads, 6.2 miles of sand-clay, 2,500 miles of gravel, 27.9 miles of bituminous concrete, and 335.5 miles



of Portland cement concrete, in addition to which there are bridges with a total length of 0.6 mile.

The total cost of the roads completed, including 174.9 miles of stage construction, was \$7,435,078.06, of which the Federal share was \$3,173,974.52. The disbursement of Federal funds to the State was \$2,294,445.91. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$19,591,780, leaves a balance of \$2,658,903.46 of unexpended funds to the credit of the State.

#### MISSISSIPPI

The Federal-aid highway system includes 3,604 miles, of which 1,158.9 miles have been improved with Federal aid. Of the improved mileage 286.4 miles were added during the year. At the close of the year 330.7 miles were under construction and 95.1 miles were approved.

The mileage improved with Federal aid consists of 136.4 miles of graded and drained earth roads, 20.6 miles of sand-clay, 873.6 miles of gravel, 11.1 miles of water-bound macadam, 1 mile of bituminous macadam, 9.2 miles of bituminous concrete, 97.1 miles of Portland cement concrete, and 9.2 miles of brick, in addition to which there are bridges with a total length of 0.5 mile.

The total cost of the roads completed, including 36.6 miles of stage construction, was \$4,340,617.88, of which the Federal share was \$2,169,238.93. The disbursement of Federal funds to the State was \$1,554,835.53. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$12,128,018, leaves a balance of \$3,007,839.31 of unexpended funds to the credit of the State.

#### MISSOURI

The Federal-aid highway system includes 7,530 miles, of which 1,795.7 miles have been improved with Federal aid. Of the improved mileage 446.1 miles were added during the year. At the close of the year 311.1 miles were under construction and 23.1 miles were approved.

The mileage improved with Federal aid consists of 326.8 miles of graded and drained earth roads, 842.9 miles of gravel, 13.4 miles of water-bound macadam, 50.8 miles of bituminous macadam, 17.7 miles of bituminous concrete, 528.2 miles of Portland cement concrete, and 8.5 miles of brick, in addition to which there are bridges with a total length of 7.4 miles.

The total cost of the roads completed, including 28.8 miles of stage construc-

tion, was \$15,050,108.77, of which the Federal share was \$6,583,420.13. The disbursement of Federal funds to the State was \$4,015,329.72. This, added to the disbursements made during the previous years and subtracted from the State's total apportionment of \$22,786,436, leaves a balance of \$5,989,361.91 of unexpended funds to the credit of the State.

#### MONTANA

The Federal-aid highway system includes 4,661 miles, of which 1,071.5 miles have been improved with Federal aid. Of the improved mileage 133.8 miles were added during the year. At the close of the year 116.1 miles were under construction and 145.7 miles were approved.

The mileage improved with Federal aid consists of 214.2 miles of graded and drained earth roads, 5.6 miles of sand-clay, 792.7 miles of gravel, 16 miles of water-bound macadam, 6.9 miles of bituminous macadam, 2.8 miles of bituminous concrete, and 31.3 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.3 miles.

The total cost of the roads completed was \$1,540,284.08, of which the Federal share was \$1,174,701.33. The disbursement of Federal funds to the State was \$659,904.88. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$13,424,885, leaves a balance of \$6,542,069.51 of unexpended funds to the credit of the State.

#### NEBRASKA

The Federal-aid highway system includes 5,569.1 miles, of which 2,021.2 miles have been improved with Federal aid. Of the improved mileage 146.5 miles were added during the year. At the close of the year 1,099.2 miles were under construction and 94 miles were approved.

The mileage improved with Federal aid consists of 1,213.9 miles of graded and drained earth roads, 169.2 miles of sand-clay, 559.2 miles of gravel, 10.1 miles of bituminous concrete, 46.5 miles of Portland cement concrete, and 18.6 miles of brick, in addition to which there are bridges with a total length of 3.2 miles.

The total cost of the roads completed, including 209.4 miles of stage construction, was \$1,412,172.43, of which the Federal share was \$682,658.91. The disbursement of Federal funds to the State was \$1,863,988.80. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$14,635,235, leaves a balance of

\$5,771,303.41 of unexpended funds to the credit of the State.

#### NEVADA

The Federal-aid highway system includes 1,398 miles, of which 710.1 miles have been improved with Federal aid. Of the improved mileage 282.3 miles were added during the year. At the close of the year 174.8 miles were under construction and 42.8 miles were approved.

The mileage improved with Federal aid consists of 53.8 miles of graded and drained earth roads, 26.4 miles of sand-clay, 555.3 miles of gravel, 10.2 miles of water-bound macadam, 15.6 miles of bituminous macadam, 2 miles of bituminous concrete, and 44.8 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.1 miles.

The total cost of the roads completed, including 5.1 miles of stage construction, was \$3,280,931.39, of which the Federal share was \$2,634,795.38. The disbursement of Federal funds to the State was \$1,453,240.19. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$8,795,215, leaves a balance of \$1,301,853.81 of unexpended funds to the credit of the State.

#### NEW HAMPSHIRE

The Federal-aid highway system includes 977.4 miles, of which 244.6 miles have been improved with Federal aid. Of the improved mileage 29.6 miles were added during the year. At the close of the year 19 miles were under construction and 6.9 miles were approved.

The mileage improved with Federal aid consists of 96.5 miles of gravel, 46.5 miles of water-bound macadam, 63.9 miles of bituminous macadam, 30 miles of bituminous concrete, and 5.2 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.4 miles.

The total cost of the roads completed was \$884,824.61, of which the Federal share was \$424,791.20. The disbursement of Federal funds to the State was \$298,143.45. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$3,169,492, leaves a balance of \$687,878.77 of unexpended funds to the credit of the State.

#### NEW JERSEY

The Federal-aid highway system includes 1,198.3 miles, of which 307.9 miles have been improved with Federal aid. Of the improved mileage 78.3 miles were added during the year. At

the close of the year 14 miles were under construction and 10 miles were approved.

The mileage improved with Federal aid consists of 1.6 miles of graded and drained earth roads, 0.8 mile of sand-clay, 0.5 mile of gravel, 21.9 miles of bituminous concrete, and 279.1 miles of Portland cement concrete, in addition to which there are bridges with a total length of 0.7 mile.

The total cost of the roads completed was \$4,612,641.22, of which the Federal share was \$1,347,757.63. The disbursement of Federal funds to the State was \$2,087,825.66. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$8,467,420, leaves a balance of \$1,704,648.21 of unexpended funds to the credit of the State.

#### NEW MEXICO

The Federal-aid highway system includes 3,298 miles, of which 1,490.5 miles have been improved with Federal aid. Of the improved mileage 137.5 miles were added during the year. At the close of the year 36.9 miles were under construction and 34 miles were approved.

The mileage improved with Federal aid consists of 225.8 miles of graded and drained earth roads, 5.1 miles of sand-clay, 1,181.2 miles of gravel, 0.7 mile of bituminous concrete, and 76.5 miles of Portland cement concrete, in addition to which there are bridges with a total length of 1.3 miles.

The total cost of the roads completed, including 15.8 miles of stage construction, was \$1,483,178.56, of which the Federal share was \$908,377.49. The disbursement of Federal funds to the State was \$1,020,042.23. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$10,972,386, leaves a balance of \$3,097,525.07 of unexpended funds to the credit of the State.

#### NEW YORK

The Federal-aid highway system includes 5,018 miles, of which 1,231.8 miles have been improved with Federal aid. Of the improved mileage 259.8 miles were added during the year. At the close of the year 532.6 miles were under construction and 136.6 miles were approved.

The mileage improved with Federal aid consists of 8.6 miles of gravel, 320.7 miles of bituminous macadam, 4.8 miles of bituminous concrete, 895.6 miles of Portland cement concrete, and 0.7 mile of brick, in addition to which there



are bridges with a total length of 1.5 miles.

The total cost of the roads completed was \$10,162,510, of which the Federal share was \$3,791,280.66. The disbursement of Federal funds to the State was \$4,664,644.52. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$34,045,195, leaves a balance of \$13,367,889.20 of unexpended funds to the credit of the State.

#### NORTH CAROLINA

The Federal-aid highway system includes 3,781 miles, of which 1,343.1 miles have been improved with Federal aid. Of the improved mileage 164.6 miles were added during the year. At the close of the year 105 miles were under construction and 26.1 miles were approved.

The mileage improved with Federal aid consists of 80.7 miles of graded and drained earth roads, 520.6 miles of sand-clay, 85.8 miles of gravel, 19.6 miles of water-bound macadam, 38 miles of bituminous macadam, 228.6 miles of bituminous concrete, and 367.9 miles of Portland cement concrete, in addition to which there are bridges with a total length of 1.9 miles.

The total cost of the roads completed, including 61 miles of stage construction, was \$7,385,531.70, of which the Federal share was \$3,056,122.87. The disbursement of Federal funds to the State was \$3,082,882.17. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$15,717,206, leaves a balance of \$2,842,516.78 of unexpended funds to the credit of the State.

#### NORTH DAKOTA

The Federal-aid highway system includes 6,836 miles, of which 2,275.7 miles have been improved with Federal aid. Of the improved mileage 260.4 miles were added during the year. At the close of the year 650.7 miles were under construction and 388.8 miles were approved.

The mileage improved with Federal aid consists of 1,348.4 miles of graded and drained earth roads, 1.5 miles of sand-clay, 919.6 miles of gravel, 1.2 miles of bituminous concrete, and 3 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.2 miles.

The total cost of the roads completed, including 318.2 miles of stage construction, was \$1,780,585.28, of which the Federal share was \$907,695.08. The disbursement of Federal funds to the

State was \$925,094.42. This, added to the disbursements made during previous years and subtracted from the State's apportionment of \$10,748,659, leaves a balance of \$3,947,950.29 of unexpended funds to the credit of the State.

#### OHIO

The Federal-aid highway system includes 5,900.5 miles, of which 1,422.6 miles have been improved with Federal aid. Of the improved mileage 197 miles were added during the year. At the close of the year 295 miles were under construction and 85.8 miles were approved.

The mileage improved with Federal aid consists of 47 miles of graded and drained earth roads, 82.6 miles of water-bound macadam, 303.1 miles of bituminous macadam, 88.1 miles of bituminous concrete, 454.5 miles of Portland cement concrete, and 447 miles of brick, in addition to which there are bridges with a total length of 0.1 mile.

The total cost of the roads completed was \$6,611,677.60, of which the Federal share was \$2,415,369.63. The disbursement of Federal funds to the State was \$2,472,310.12. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$25,731,796, leaves a balance of \$6,559,239.10 of unexpended funds to the credit of the State.

#### OKLAHOMA

The Federal-aid highway system includes 5,528 miles of which 1,201.5 miles have been improved with Federal aid. Of the improved mileage 291.3 miles were added during the year. At the close of the year 74.8 miles were under construction and 64.7 miles were approved.

The mileage improved with Federal aid consists of 114.3 miles of graded and drained earth roads, 2.3 miles of sand-clay, 595.7 miles of gravel, 6.3 miles of water-bound macadam, 8.4 miles of bituminous macadam, 64.5 miles of bituminous concrete, 391.7 miles of Portland cement concrete, and 8.9 miles of brick, in addition to which there are bridges with a total length of 9.4 miles.

The total cost of the roads completed, including 2 miles of stage construction, was \$6,508,352.72, of which the Federal share was \$3,063,016.96. The disbursement of Federal funds to the State was \$2,887,622.14. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$16,059,787, leaves a balance of \$2,-



399,374.70 of unexpended funds to the credit of the State.

#### OREGON

The Federal-aid highway system includes 2,814 miles, of which 961.6 miles have been improved with Federal aid. Of the improved mileage 132.4 miles were added during the year. At the close of the year 103.9 miles were under construction and 22 miles were approved.

The mileage improved with Federal aid consists of 132.6 miles of graded and drained earth roads, 656.1 miles of gravel, 25.6 miles of water-bound macadam, 0.8 mile of bituminous macadam, 52.9 miles of bituminous concrete, and 91.5 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.3 miles.

The total cost of the roads completed, including 7.7 miles of stage construction, was \$2,616,671.11, of which the Federal share was \$1,434,973.97. The disbursement of Federal funds to the State was \$1,656,072.98. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$10,879,347, leaves a balance of \$1,431,330.61 of unexpended funds to the credit of the State.

#### PENNSYLVANIA

The Federal-aid highway system includes 4,090.5 miles, of which 1,435.2 miles have been improved with Federal aid. Of the improved mileage 447.6 miles were added during the year. At the close of the year 283.3 miles were under construction and 57.4 miles were approved.

The mileage improved with Federal aid consists of 32.9 miles of graded and drained earth roads, 3.4 miles of gravel, 7.8 miles of bituminous macadam, 101.1 miles of bituminous concrete, 1,266.9 miles of Portland cement concrete, and 26.4 miles of brick.

The total cost of the roads completed was \$23,774,022.81, of which the Federal share was \$6,574,796.61. The disbursement of Federal funds to the State was \$5,772,232.58. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$31,338,781, leaves a balance of \$5,910,862.03 of unexpended funds to the credit of the State.

#### RHODE ISLAND

The Federal-aid highway system includes 242.4 miles, of which 94.3 miles have been improved with Federal aid. Of the improved mileage 23.5

miles were added during the year. At the close of the year 20.9 miles were under construction and 8.3 miles were approved.

The mileage improved with Federal aid consists of 1.9 miles of water-bound macadam, 16.5 miles of bituminous macadam, 38.3 miles of bituminous concrete, and 37.5 miles of Portland cement concrete.

The total cost of the roads completed was \$1,165,514.70, of which the Federal share was \$390,685.01. The disbursement of Federal funds to the State was \$285,490.94. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$2,667,569, leaves a balance of \$1,108,739.94 of unexpended funds to the credit of the State.

#### SOUTH CAROLINA

The Federal-aid highway system includes 3,230 miles, of which 1,536.9 miles have been improved with Federal aid. Of the improved mileage 225.8 miles were added during the year. At the close of the year 185.9 miles were under construction and 19.2 miles were approved.

The mileage improved with Federal aid consists of 34.2 miles of graded and drained earth roads, 1,232.7 miles of sand-clay, 114.5 miles of gravel, 6 miles of water-bound macadam, 3 miles of bituminous macadam, 63.5 miles of bituminous concrete, 75 miles of Portland cement concrete, and 0.2 mile of brick, in addition to which there are bridges with a total length of 7.8 miles.

The total cost of the roads completed, including 14.2 miles of stage construction, was \$4,750,910.07, of which the Federal share was \$2,178,552.57. The disbursement of Federal funds to the State was \$1,810,458.38. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$9,801,524, leaves a balance of \$1,553,790.08 of unexpended funds to the credit of the State.

#### SOUTH DAKOTA

The Federal-aid highway system includes 5,731 miles, of which 2,345.8 miles have been improved with Federal aid. Of the improved mileage 765.9 miles were added during the year. At the close of the year 468.7 miles were under construction and 119.8 miles were approved.

The mileage improved with Federal aid consists of 481.1 miles of graded and drained earth roads, 18.2 miles of sand-clay, 1,843.3 miles of gravel, and 1.2 miles of Portland cement concrete,

in addition to which there are bridges with a total length of 1.9 miles.

The total cost of the roads completed, including 47.4 miles of stage construction, was \$4,915,754.67, of which the Federal share was \$2,368,152.66. The disbursement of Federal funds to the States was \$1,828,659.29. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$11,166,790, leaves a balance of \$1,796,628.42 of unexpended funds to the credit of the State.

#### TENNESSEE

The Federal-aid highway system includes 3,252.8 miles, of which 835.3 miles have been improved with Federal aid. Of the improved mileage 238.8 miles were added during the year. At the close of the year 193.1 miles were under construction and 24.6 miles were approved.

The mileage improved with Federal aid consists of 140.6 miles of graded and drained earth roads, 117 miles of gravel, 52.3 miles of water-bound macadam, 401.8 miles of bituminous macadam, 21.9 miles of bituminous concrete, and 100.3 miles of Portland cement concrete, in addition to which there are bridges with a total length of 1.4 miles.

The total cost of the roads completed was \$6,206,668.39, of which the Federal share was \$2,691,356.46. The disbursement of Federal funds to the State was \$2,364,696.15. This, added to the disbursement made during previous years and subtracted from the State's total apportionment of \$15,280,591, leaves a balance of \$3,203,506.19 of unexpended funds to the credit of the State.

#### TEXAS

The Federal-aid highway system includes 11,129 miles, of which 5,055.8 miles have been improved with Federal aid. Of the improved mileage 723.5 miles were added during the year. At the close of the year 771.8 miles were under construction and 61.4 miles were approved.

The mileage improved with Federal aid consists of 672.7 miles of graded and drained earth roads, 83.9 miles of sand-clay, 2,862.6 miles of gravel, 476.9 miles of water-bound macadam, 449.7 miles of bituminous macadam, 121.7 miles of bituminous concrete, 351.7 miles of Portland cement concrete, and 29.2 miles of brick, in addition to which there are bridges with a total length of 6.9 miles.

The total cost of the roads completed, including 41.3 miles of stage construc-

tion, was \$9,403,940.27, of which the Federal share was \$4,348,097.85. The disbursement of Federal funds to the State was \$5,284,156.01. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$40,606,431, leaves a balance of \$9,195,341.92 of unexpended funds to the credit of the State.

#### UTAH

The Federal-aid highway system includes 1,588 miles, of which 622.6 miles have been improved with Federal aid. Of the improved mileage 135.2 miles were added during the year. At the close of the year 77.8 miles were under construction and 49.4 miles were approved.

The mileage improved with Federal aid consists of 94.2 miles of graded and drained earth roads, 41.7 miles of sand-clay, 373.7 miles of gravel, 9.3 miles of water-bound macadam, 0.7 mile of bituminous macadam, 9.9 miles of bituminous concrete, and 91.6 miles of Portland cement concrete, in addition to which there are bridges with a total length of 1.6 miles.

The total cost of the roads completed was \$1,705,348.27, of which the Federal share was \$1,185,427.86. The disbursement of Federal funds to the State was \$1,081,703.45. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$7,818,779 leaves a balance of \$1,790,016.98 of unexpended funds to the credit of the State.

#### VERMONT

The Federal-aid highway system includes 1,043 miles, of which 135.2 miles have been improved with Federal aid. Of the improved mileage 27.2 miles were added during the year. At the close of the year 33.9 miles were under construction and 1.5 miles were approved.

The mileage improved with Federal aid consists of 87.1 miles of gravel, 3.4 miles of water-bound macadam, 25 miles of bituminous macadam, and 16.1 miles of Portland cement concrete, in addition to which there are bridges with a total length of 3.7 miles.

The total cost of the roads completed was \$1,239,157.62, of which the Federal share was \$565,771.50. The disbursement of Federal funds to the State was \$415,055.81. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$3,268,507, leaves a balance of \$1,107,116.53 of unexpended funds to the credit of the State.



## VIRGINIA

The Federal-aid highway system includes 3,075.5 miles, of which 1,050.1 miles have been improved with Federal aid. Of the improved mileage 190.5 miles were added during the year. At the close of the year 141.1 miles were under construction and 10.9 miles were approved.

The mileage improved with Federal aid consists of 51.7 miles of graded and drained earth roads, 202.1 miles of sand-clay, 113.9 miles of gravel, 108.5 miles of water-bound macadam, 249.1 miles of bituminous macadam, 10.6 miles of bituminous concrete, and 312.7 miles of Portland cement concrete, in addition to which there are bridges with a total length of 1.6 miles.

The total cost of the roads completed was \$5,097,604.77, of which the Federal share was \$2,302,948.28. The disbursement of Federal funds to the State was \$2,514,371.36. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$13,501,514, leaves a balance of \$2,100,408.27 of unexpended funds to the credit of the State.

## WASHINGTON

The Federal-aid highway system includes 2,907.7 miles, of which 668.6 miles have been improved with Federal aid. Of the improved mileage 116.7 miles were added during the year. At the close of the year 41.1 miles were under construction and 45.3 miles were approved.

The mileage improved with Federal aid consists of 108.8 miles of graded and drained earth roads, 311.3 miles of gravel, and 246.4 miles of Portland cement concrete, in addition to which there are bridges with a total length of 2.1 miles.

The total cost of the roads completed, including 3.7 miles of stage construction, was \$2,590,118.96, of which the Federal share was \$1,120,697.59. The disbursement of Federal funds to the State was \$1,430,361.90. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$10,145,776, leaves a balance of \$1,807,776.23 of unexpended funds to the credit of the State.

## WEST VIRGINIA

The Federal-aid highway system includes 1,994 miles, of which 414.5 miles have been improved with Federal aid. Of the improved mileage 78.6 miles were added during the year. At the close of

the year 115.5 miles were under construction and 40.3 miles were approved.

The mileage improved with Federal aid consists of 165.4 miles of graded and drained earth roads, 5.6 miles of sand-clay, 18.3 miles of gravel, 4.9 miles of water-bound macadam, 101.9 miles of bituminous macadam, 16.3 miles of bituminous concrete, 90.2 miles of Portland cement concrete, and 11.4 miles of brick, in addition to which there are bridges with a total length of 0.5 mile.

The total cost of the roads completed, including 13 miles of stage construction, was \$2,731,548.14, of which the Federal share was \$1,169,766.23. The disbursement of Federal funds to the State was \$1,096,945.39. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$7,352,511, leaves a balance of \$1,886,867.19 of unexpended funds to the credit of the State.

## WISCONSIN

The Federal-aid highway system includes 5,493.4 miles, of which 1,619.1 miles have been improved with Federal aid. Of the improved mileage 134.5 miles were added during the year. At the close of the year 286.4 miles were under construction and 102.8 miles were approved.

The mileage improved with Federal aid consists of 213.7 miles of graded and drained earth roads, 115.5 miles of sand-clay, 843.6 miles of gravel, 2.7 miles of water-bound macadam, 9.6 miles of bituminous macadam, and 433.9 miles of Portland cement concrete.

The total cost of the roads completed, including 27.1 miles of stage construction, was \$2,688,018.38, of which the Federal share was \$1,291,022.45. The disbursement of Federal funds to the State was \$1,700,875.89. This, added to the disbursements made during previous years and subtracted from the State's total apportionment of \$17,438,815, leaves a balance of \$6,131,946.01 of unexpended funds to the credit of the State.

## WYOMING

The Federal-aid highway system includes 3,071.7 miles, of which 1,225.1 miles have been improved with Federal aid. Of the improved mileage 187.3 miles were added during the year. At the close of the year 122.1 miles were under construction and 10.4 miles were approved.

The mileage improved with Federal aid consists of 359.8 miles of graded and



drained earth roads, 488.8 miles of sand-clay, 335.6 miles of gravel, 22.1 miles of bituminous concrete, and 14.7 miles of Portland cement concrete, in addition to which there are bridges with a total length of 4.1 miles.

The total cost of the roads completed, including 50.8 miles of stage construction, was \$2,739,675.86, of which the Federal share was \$1,725,258.41. The disbursement of Federal funds to the State was \$1,212,767.42. This, added to the disbursements made

during previous years and subtracted from the State's total apportionment of \$8,566,274, leaves a balance of \$1,330,970.09 of unexpended funds to the credit of the State.

Complete statistics of the Federal-aid roads completed during the year and during the entire period under the Federal-aid plan with reference to mileage and types completed and the total costs and Federal-aid allotments, etc., are given in Tables 9 to 19, inclusive.

TABLE 9.—Total cost, Federal aid and mileage of Federal-aid roads, original and stage construction, completed during the fiscal year 1926, by States

State	Total cost	Federal aid	Miles (original)	Miles (stage)
Alabama.....	\$4,288,712.99	\$1,831,731.14	262.0	-----
Arizona.....	1,378,605.07	885,678.50	96.5	-----
Arkansas.....	4,375,795.99	2,317,678.87	281.6	-----
California.....	5,727,131.79	2,752,692.79	222.8	7.1
Colorado.....	1,923,572.30	966,142.48	84.5	1.9
Connecticut.....	395,689.66	136,570.00	8.7	-----
Delaware.....	269,509.49	127,843.85	8.6	-----
Florida.....	1,700,890.98	818,937.01	36.9	-----
Georgia.....	5,141,532.68	2,504,419.51	322.7	20.4
Idaho.....	2,081,356.55	1,320,858.71	133.8	36.0
Illinois.....	5,177,738.18	2,532,879.71	182.4	.6
Indiana.....	5,432,841.65	2,584,668.72	157.2	-----
Iowa.....	2,589,254.14	1,170,140.16	138.6	12.4
Kansas.....	4,023,851.60	2,034,853.94	269.1	19.6
Kentucky.....	5,919,328.90	2,252,781.48	188.8	34.0
Louisiana.....	908,749.55	362,623.35	44.3	-----
Maine.....	388,599.74	192,580.02	15.6	-----
Maryland.....	1,985,590.44	901,945.32	103.3	-----
Massachusetts.....	3,717,850.99	932,863.07	56.8	-----
Michigan.....	4,599,169.26	1,985,509.96	134.1	3.9
Minnesota.....	7,435,078.06	3,173,974.52	528.0	174.9
Mississippi.....	4,340,617.88	2,169,238.93	286.4	36.6
Missouri.....	15,050,108.77	6,583,420.13	446.1	28.8
Montana.....	1,540,284.08	1,174,701.33	133.8	-----
Nebraska.....	1,412,172.43	682,658.91	146.5	209.4
Nevada.....	3,280,931.39	2,634,795.38	282.3	5.1
New Hampshire.....	884,824.61	424,791.20	29.6	-----
New Jersey.....	4,612,641.22	1,347,757.63	78.3	-----
New Mexico.....	1,483,178.56	908,377.49	137.5	15.8
New York.....	10,162,510.00	3,791,280.66	259.8	-----
North Carolina.....	7,385,531.70	3,056,122.87	164.6	61.0
North Dakota.....	1,780,585.28	907,695.08	260.4	318.2
Ohio.....	6,611,677.60	2,415,369.63	197.0	-----
Oklahoma.....	6,508,352.72	3,063,016.96	291.3	2.0
Oregon.....	2,616,671.11	1,434,973.97	132.4	7.7
Pennsylvania.....	23,774,022.81	6,574,796.61	447.6	-----
Rhode Island.....	1,165,514.70	390,685.01	23.5	-----
South Carolina.....	4,750,910.07	2,178,552.57	225.8	14.2
South Dakota.....	4,915,754.67	2,368,152.66	765.9	47.4
Tennessee.....	6,206,668.39	2,691,356.46	238.8	-----
Texas.....	9,403,940.27	4,348,097.85	723.5	41.3
Utah.....	1,705,348.27	1,185,427.86	135.2	-----
Vermont.....	1,239,157.62	565,771.50	27.2	-----
Virginia.....	5,097,604.77	2,302,948.28	190.5	-----
Washington.....	2,590,118.96	1,120,697.59	116.7	3.7
West Virginia.....	2,731,548.14	1,169,766.23	78.6	13.0
Wisconsin.....	2,688,018.38	1,291,022.45	134.5	27.1
Wyoming.....	2,739,675.86	1,725,258.41	187.3	50.8
Total.....	206,139,220.27	90,294,106.76	9,417.3	1,193.0

TABLE 10.—Total cost, Federal aid and mileage of Federal-aid roads completed to June 30, 1926, by States

State	Total cost	Federal aid	Miles <sup>1</sup>
Alabama.....	\$20,752,585.99	\$9,883,424.48	1,415.7
Arizona.....	11,529,325.07	6,250,194.69	767.1
Arkansas.....	20,257,932.75	8,543,898.76	1,418.5
California.....	30,235,379.81	14,558,628.81	1,169.7
Colorado.....	15,225,844.16	7,801,628.50	797.0
Connecticut.....	5,977,829.01	2,273,863.66	127.1
Delaware.....	4,918,052.29	1,781,665.00	124.3
Florida.....	7,989,517.80	3,878,287.87	249.7
Georgia.....	27,704,198.26	13,109,068.58	1,975.5
Idaho.....	11,780,741.23	6,325,103.42	773.7
Illinois.....	46,638,676.52	21,878,422.04	1,467.1
Indiana.....	22,596,658.46	10,900,346.83	687.2
Iowa.....	30,191,682.82	12,432,933.15	2,177.0
Kansas.....	34,446,612.82	13,356,124.78	1,263.6
Kentucky.....	21,319,134.37	8,742,516.65	687.4
Louisiana.....	14,281,859.04	6,359,336.43	1,069.8
Maine.....	8,747,552.76	4,192,507.39	303.6
Maryland.....	10,924,943.10	5,112,991.22	423.3
Massachusetts.....	13,217,639.13	6,898,383.20	385.7
Michigan.....	27,354,859.45	12,474,303.21	995.8
Minnesota.....	37,850,763.95	15,912,616.56	3,249.2
Mississippi.....	15,716,707.96	7,699,843.80	1,158.9
Missouri.....	37,571,342.54	17,289,927.52	1,795.7
Montana.....	11,914,279.06	6,607,530.55	1,071.5
Nebraska.....	14,379,018.01	6,868,788.86	2,021.2
Nevada.....	9,315,505.61	6,659,890.11	710.1
New Hampshire.....	5,260,569.51	2,510,351.32	244.6
New Jersey.....	17,680,844.26	5,378,452.37	307.9
New Mexico.....	13,200,059.12	7,851,157.91	1,490.5
New York.....	45,457,079.79	18,626,087.19	1,231.8
North Carolina.....	30,689,430.76	12,741,518.72	1,343.1
North Dakota.....	13,512,576.29	6,602,989.10	2,275.7
Ohio.....	49,367,650.24	18,074,453.82	1,422.6
Oklahoma.....	28,915,946.93	13,484,856.58	1,201.5
Oregon.....	17,612,858.41	8,945,203.93	961.6
Pennsylvania.....	74,812,072.67	25,106,966.83	1,435.2
Rhode Island.....	4,320,206.69	1,672,904.06	94.3
South Carolina.....	17,188,668.82	7,779,376.11	1,536.9
South Dakota.....	18,190,591.85	8,948,632.65	2,345.8
Tennessee.....	23,140,785.61	10,995,924.23	835.3
Texas.....	71,403,346.64	28,461,138.70	5,055.8
Utah.....	9,054,232.80	5,691,043.97	622.6
Vermont.....	4,273,969.26	2,028,484.51	135.2
Virginia.....	23,410,491.32	10,972,568.65	1,050.1
Washington.....	17,078,511.63	7,782,909.46	668.6
West Virginia.....	10,258,141.20	4,491,428.66	414.6
Wisconsin.....	25,353,034.20	10,638,396.73	1,619.1
Wyoming.....	12,383,388.08	6,977,481.63	1,225.1
<b>Total.....</b>	<b>1,051,403,098.66</b>	<b>455,554,553.90</b>	<b>55,902.8</b>

<sup>1</sup> Mileage is of original improvement only.

TABLE 11.—*Total program, as of June 30, 1926, of projects which have been approved for construction, completed, and under construction*

State	Total cost	Federal aid	Miles <sup>1</sup>
Alabama.....	\$23,284,832.30	\$11,100,976.84	1,505.6
Arizona.....	12,434,048.56	6,859,370.61	823.4
Arkansas.....	23,512,523.69	10,108,969.67	1,662.9
California.....	39,081,457.75	18,833,239.76	1,396.1
Colorado.....	19,088,510.90	9,646,108.31	981.3
Connecticut.....	9,598,798.46	3,243,368.71	175.0
Delaware.....	6,657,124.45	2,470,554.40	168.2
Florida.....	13,757,718.54	6,470,127.88	412.6
Georgia.....	38,491,387.83	18,391,276.95	2,479.2
Idaho.....	14,786,598.24	8,125,589.22	959.7
Illinois.....	51,090,570.82	23,981,923.50	1,615.3
Indiana.....	34,437,733.91	16,373,269.82	1,014.0
Iowa.....	41,757,635.54	18,026,081.34	2,910.3
Kansas.....	46,397,579.03	17,883,140.14	1,942.4
Kentucky.....	26,464,612.40	11,206,226.75	1,041.9
Louisiana.....	18,142,124.68	8,195,790.12	1,247.0
Maine.....	12,456,663.60	5,603,302.50	416.5
Maryland.....	12,718,748.86	5,901,022.86	511.7
Massachusetts.....	23,291,788.14	7,991,338.63	442.2
Michigan.....	36,335,853.36	16,525,595.18	1,221.1
Minnesota.....	46,945,265.85	19,110,116.56	3,784.3
Mississippi.....	23,692,089.82	11,565,407.79	1,684.7
Missouri.....	50,773,350.17	22,380,474.90	2,129.9
Montana.....	14,921,271.47	8,873,740.57	1,333.3
Nebraska.....	25,825,944.03	12,454,863.87	3,214.4
Nevada.....	11,063,376.38	8,151,533.26	927.7
New Hampshire.....	6,091,694.33	2,878,433.12	270.5
New Jersey.....	23,727,643.27	7,767,919.65	331.9
New Mexico.....	14,321,053.77	8,670,686.83	1,561.4
New York.....	85,507,902.79	29,081,137.39	1,901.0
North Carolina.....	35,680,608.02	14,979,929.82	1,474.2
North Dakota.....	20,676,546.93	10,244,297.92	3,315.2
Ohio.....	62,234,909.87	22,993,480.84	1,803.4
Oklahoma.....	31,867,684.07	14,858,244.75	1,341.0
Oregon.....	20,700,118.70	10,624,852.11	1,087.5
Pennsylvania.....	89,685,731.95	29,639,774.39	1,775.9
Rhode Island.....	6,005,811.05	2,110,349.06	123.5
South Carolina.....	21,714,922.77	9,764,377.98	1,742.0
South Dakota.....	21,736,291.75	10,767,488.42	2,934.3
Tennessee.....	30,769,343.75	14,395,266.07	1,053.0
Texas.....	90,672,097.66	36,969,487.39	5,889.0
Utah.....	10,728,064.59	6,967,500.25	749.8
Vermont.....	6,151,017.44	2,762,711.14	170.6
Virginia.....	28,860,277.96	13,399,057.56	1,202.1
Washington.....	21,559,979.03	9,850,509.46	755.0
West Virginia.....	15,961,339.69	6,721,219.19	570.3
Wisconsin.....	33,434,428.85	14,587,911.92	2,008.3
Wyoming.....	13,690,412.82	7,785,318.07	1,357.6
Hawaii.....	1,050,897.93	312,635.18	15.9
Total.....	1,369,836,387.77	597,605,998.65	69,334.1

<sup>1</sup> Mileage is of original improvement only.



TABLE 12.—*Mileage of Federal-aid roads completed during the fiscal year 1926, by types of construction*

State	Graded and drained	Sand-clay	Gravel	Water-bound macadam	Bituminous macadam	Bituminous concrete	Portland cement concrete	Brick	Bridges	Total
Alabama.....	25.1	101.6	117.5		<sup>1</sup> —20.2	<sup>1</sup> —5.9	43.3		0.6	262.0
Arizona.....	<sup>1</sup> —47.4	66.4	62.3			6.2	9.2			96.6
Arkansas.....			191.9	7.9	23.0	5.0	53.7		.3	281.6
California.....	31.5		70.6			17.7	102.2		.8	222.8
Colorado.....	3.4	1.0	61.0				18.4		.7	84.5
Connecticut.....							8.7			8.7
Delaware.....							8.6			8.6
Florida.....	<sup>1</sup> —8.2			13.6	7.8	10.5	11.0		2.3	36.9
Georgia.....	31.1	169.8	62.3	8.8	19.8	3.4	23.7		4.1	322.7
Idaho.....	12.9	<sup>1</sup> —2	109.1			.7	11.5			133.8
Illinois.....							182.1			182.4
Indiana.....	5.8		6.4	<sup>1</sup> —7.5			152.6			157.2
Iowa.....	64.2		36.1				38.5		.1	138.6
Kansas.....	148.1	17.0	58.7		28.1	.4	<sup>1</sup> —1.7	17.4	.8	269.1
Kentucky.....	101.2		8.2	.3	34.0		45.9		<sup>1</sup> —6	188.8
Louisiana.....			36.9			2.8	3.6		1.2	44.3
Maine.....			6.2		9.4					15.6
Maryland.....	.9				65.3		37.3			103.3
Massachusetts.....					14.8	6.6	34.2		1.2	56.8
Michigan.....	3.5		<sup>1</sup> —5		5.4	<sup>1</sup> —2.7	128.4			134.1
Minnesota.....	144.4	6.2	351.4			2.0	23.8		.2	528.0
Mississippi.....	12.8	2.2	247.2				23.7		.3	286.4
Missouri.....	63.5		117.6		1.9		256.4	2.3	4.4	446.1
Montana.....	<sup>1</sup> —1.6	5.6	127.8			1.9			.4	133.8
Nebraska.....	<sup>1</sup> —3	37.0	113.6		.7	<sup>1</sup> —7.3			2.3	146.5
Nevada.....	19.1	1.5	251.1	10.2	<sup>1</sup> —5.0	.4	4.4		.7	282.3
New Hampshire.....			1.7	14.5	11.1		9		1.3	29.6
New Jersey.....		.8	.5			9.3	67.2		.6	78.3
New Mexico.....	33.5		93.1				10.5		.5	137.5
New York.....			8.6		52.8		198.5			259.8
North Carolina.....	12.1					63.3	88.9		.3	164.6
North Dakota.....	228.8		31.2						.6	260.4
Ohio.....	15.8				56.8		76.2	48.0		197.0
Oklahoma.....	75.9		69.0		7.8		132.2	4.9	1.5	291.3
Oregon.....	42.2		82.6		.8		5.8		1.2	152.4
Pennsylvania.....	32.9					<sup>1</sup> —8	414.2	1.2		447.6
Rhode Island.....				1.9	6.0	1.3	14.2			23.5
South Carolina.....	26.2	155.4	13.6	6.0		10.4	10.2		4.0	225.8
South Dakota.....	323.9		440.7				.4		.8	765.9
Tennessee.....	127.5		22.6		38.4		49.5		.8	238.8
Texas.....	375.3	29.3	161.1	2.5	107.1	44.0	14.2	4.4	<sup>1</sup> —14.9	723.5
Utah.....	<sup>1</sup> —6.9	4.1	131.4		.7	2.1	3.6		.3	135.2
Vermont.....			14.3		5.3		5.3		2.4	27.2
Virginia.....	24.7	2.4	29.2		62.9		71.1		.3	190.5
Washington.....	65.2		19.9				31.3		.3	116.7
West Virginia.....	40.0	3.9			19.1		15.3		.3	78.6
Wisconsin.....	9.4		82.0				43.0			134.5
Wyoming.....	125.0	23.5	37.7						1.1	187.3
Total.....	2,161.3	627.3	3,274.1	58.2	553.2	179.6	2,464.3	78.1	21.3	9,417.3

<sup>1</sup> Negative figures caused by revision of records when final vouchers were paid on projects the type of which was changed after ratification of project agreement.

TABLE 13.—*Mileage of Federal-aid roads completed to June 30, 1926, by types of construction*

States	Graded and drained	Sand-clay	Gravel	Water-bound macadam	Bituminous macadam	Bituminous concrete	Portland cement concrete	Brick	Bridges	Total
Alabama.....	28.3	417.5	768.6	6.0	58.8	80.8	52.9	-----	2.8	1,415.7
Arizona.....	92.4	122.3	404.8	14.2	-----	22.7	108.6	-----	2.2	767.1
Arkansas.....	-----	3.1	919.2	48.2	84.1	248.4	114.1	-----	1.6	1,418.5
California.....	276.9	-----	280.4	18.1	55.5	67.3	468.9	-----	2.6	1,169.7
Colorado.....	172.5	76.8	352.7	-----	-----	5.9	184.7	-----	4.4	797.0
Connecticut.....	-----	-----	-----	8.8	27.0	-----	91.3	-----	-----	127.1
Delaware.....	-----	-----	-----	-----	-----	-----	117.9	6.2	.2	124.3
Florida.....	11.8	34.1	-----	13.6	72.6	23.3	81.7	10.1	2.6	249.7
Georgia.....	96.2	1,194.9	345.7	41.7	95.9	15.9	161.9	.5	23.1	1,975.5
Idaho.....	165.6	18.6	514.0	4.3	-----	37.6	32.8	-----	1.1	773.7
Illinois.....	112.3	-----	-----	-----	3.3	8.1	1,315.9	25.8	1.4	1,467.1
Indiana.....	25.6	-----	33.5	-----	17.0	12.0	597.6	-----	1.6	687.2
Iowa.....	1,303.4	-----	425.5	-----	-----	-----	425.9	22.0	.3	2,177.0
Kansas.....	313.0	112.2	180.8	4.5	84.6	3.5	439.2	123.0	2.5	1,263.6
Kentucky.....	388.9	-----	118.9	41.4	139.8	-----	94.5	3.9	.2	787.4
Louisiana.....	3.4	-----	1,037.1	3.2	9.5	10.4	3.6	-----	2.8	1,069.8
Maine.....	-----	-----	126.7	-----	137.4	-----	39.3	-----	.2	303.6
Maryland.....	4.7	-----	31.5	.1	106.9	12.3	268.0	-----	-----	423.3
Massachusetts.....	-----	-----	-----	3.3	199.2	36.8	143.9	-----	2.5	385.7
Michigan.....	29.2	-----	316.1	18.9	10.4	73.4	547.4	.4	-----	995.8
Minnesota.....	379.0	6.2	2,500.0	-----	-----	27.9	335.5	-----	.6	3,249.2
Mississippi.....	136.4	20.6	873.6	11.1	1.0	9.2	97.1	9.2	.5	1,158.9
Missouri.....	326.8	-----	842.9	13.4	50.8	17.7	528.2	8.5	7.4	1,795.7
Montana.....	214.2	5.6	792.7	16.0	6.9	2.8	31.3	-----	2.3	1,071.5
Nebraska.....	1,213.9	169.2	559.2	-----	-----	10.1	46.5	18.6	3.2	2,021.2
Nevada.....	53.8	26.4	555.3	10.2	15.6	2.0	44.8	-----	2.1	710.1
New Hampshire.....	-----	-----	96.5	46.5	63.9	30.0	5.2	-----	2.4	244.6
New Jersey.....	1.6	.8	3.9	-----	-----	21.9	279.1	-----	.7	307.9
New Mexico.....	225.8	5.1	1,181.2	-----	-----	.7	76.5	-----	1.3	1,490.5
New York.....	-----	-----	8.6	-----	320.7	4.8	895.6	.7	1.5	1,231.8
North Carolina.....	80.7	520.6	85.8	19.6	38.0	228.6	367.9	-----	1.9	1,343.1
North Dakota.....	1,348.4	1.5	919.6	-----	-----	1.2	3.0	-----	2.2	2,275.7
Ohio.....	47.0	-----	-----	82.6	303.1	88.1	454.5	447.0	.1	1,422.6
Oklahoma.....	114.3	2.3	595.7	6.3	8.4	64.5	391.7	8.9	9.4	1,201.5
Oregon.....	132.6	-----	656.1	25.6	.8	52.9	91.5	-----	2.3	961.6
Pennsylvania.....	32.9	-----	-----	-----	7.8	101.1	1,266.9	26.4	-----	1,435.2
Rhode Island.....	-----	-----	-----	1.9	16.5	38.3	37.5	-----	-----	94.3
South Carolina.....	34.2	1,232.7	114.5	6.0	3.0	63.5	75.0	.2	7.8	1,536.9
South Dakota.....	481.1	18.2	1,843.3	-----	-----	-----	1.2	-----	1.9	2,345.8
Tennessee.....	140.6	-----	117.0	52.3	401.8	21.9	100.3	-----	1.4	835.3
Texas.....	672.7	83.9	2,862.6	476.9	449.7	121.7	351.7	29.2	6.9	5,055.8
Utah.....	94.2	41.7	373.7	9.3	.7	9.9	91.6	-----	1.6	622.6
Vermont.....	-----	-----	87.1	3.4	25.0	-----	16.1	-----	3.7	135.2
Virginia.....	51.7	202.1	113.9	108.5	249.1	10.6	312.7	-----	1.6	1,050.1
Washington.....	108.8	-----	311.3	-----	-----	-----	246.4	-----	2.1	668.6
West Virginia.....	165.4	5.6	18.3	4.9	101.9	16.3	90.2	11.4	.5	414.5
Wisconsin.....	213.7	115.5	843.6	2.7	9.6	-----	433.9	-----	-----	1,619.1
Wyoming.....	359.8	488.8	335.6	-----	-----	22.1	14.7	-----	4.1	1,225.1
Total.....	9,653.7	4,926.2	22,547.3	1,123.3	3,176.3	1,626.1	11,976.6	752.0	121.6	55,902.8

TABLE 14.—*Mileage of Federal-aid roads under construction on June 30, 1926, by types of construction*

States	Graded and drained	Sand-clay	Gravel	Water-bound macadam	Bituminous macadam	Bituminous concrete	Portland cement concrete	Brick	Bridges	Total
Alabama	44.1				9.3	6.8	28.9		0.9	89.9
Arizona		16.2	27.7						.3	44.1
Arkansas			156.8	12.1	42.5		.6		1.2	213.3
California	57.8		74.7			9.2	64.2		2.3	208.2
Colorado	80.9	6.9	55.2				18.1		1.4	162.5
Connecticut	1.5			2.2			33.6		.7	38.0
Delaware							28.2		.1	28.2
Florida	65.9		8.2	22.9	7.1	32.4	22.3		4.1	162.9
Georgia	127.0	179.1	75.0	35.6	14.3	7.5	34.5		2.4	475.4
Idaho	8.1	6.0	79.1			8.6	11.4		.4	113.5
Illinois	1.6						122.7			124.4
Indiana	3.1			45.1			214.2	11.0	1.8	275.1
Iowa	368.8		69.3				148.2		.4	586.7
Kansas	345.3	38.9	29.6		39.9		66.5	25.1	3.6	548.9
Kentucky	231.1				12.0		7.7		.1	250.9
Louisiana	21.8		124.6						.9	147.4
Maine			35.1		15.0		16.2		1.1	67.3
Maryland					4.9		25.8			30.7
Massachusetts					13.3		20.2		1.8	35.4
Michigan	10.1		40.4				162.9		.3	213.7
Minnesota	279.4		137.7			4.8	102.0			524.0
Mississippi	134.8		138.3				57.5		.1	330.7
Missouri	51.3		21.2				223.0	12.5	3.0	311.1
Montana			116.1							116.1
Nebraska	319.8	90.3	667.0				20.3		1.9	1,099.2
Nevada	5.4		164.2		4.7				.5	174.8
New Hampshire			1.6	9.1	6.9		1.3		.1	19.0
New Jersey	4.5						8.7		.8	14.0
New Mexico			34.1				2.4		.3	36.9
New York	35.2		38.2		37.6	7.0	414.5			532.6
North Carolina						8.6	95.8		.6	105.0
North Dakota	494.6	11.1	143.7				.4		.8	650.7
Ohio	37.5			28.3	86.0	5.7	119.6	17.4	.5	295.0
Oklahoma	33.2		15.3			5.7	18.3		2.3	74.8
Oregon	56.1		47.5						.4	103.9
Pennsylvania	97.7						185.5			283.3
Rhode Island					6.6	2.4	11.9			20.9
South Carolina	20.6	124.4	18.5			4.4	13.8		4.3	185.9
South Dakota	385.1		83.2						.4	468.7
Tennessee	93.3		6.8		28.3	5.8	58.3		.5	193.1
Texas	179.5		165.6	44.9	211.5	28.0	141.5		.8	771.8
Utah			77.6						.1	77.8
Vermont			12.7		9.9		9.2		2.1	33.9
Virginia	3.2	12.0	6.1		60.3		58.4		1.1	141.1
Washington	17.0		22.0						2.0	41.1
West Virginia	16.4				32.9	24.5	41.7			115.5
Wisconsin			187.9		4.2		92.5		1.9	286.4
Wyoming	53.8		64.2				4.1		.1	122.1
Hawaii						6.5	9.4			15.9
Total	3,685.6	484.9	2,945.2	200.2	647.2	167.9	2,716.4	66.0	48.4	10,961.8



TABLE 15.—*Mileage of Federal-aid roads approved for construction on June 30, 1926*

States	Graded and drained	Sand-clay	Gravel	Water-bound macadam	Bituminous macadam	Bituminous concrete	Portland cement concrete	Brick	Bridges	Total
Arizona.....	12.2									12.2
Arkansas.....			29.5				1.7			31.1
California.....							18.2			18.2
Colorado.....			10.1				11.6		0.1	21.8
Connecticut.....							9.6		.3	9.9
Delaware.....							15.5		.3	15.7
Georgia.....	11.8	12.0	4.4	0.2						28.3
Idaho.....	55.2		8.6				7.7		.9	72.5
Illinois.....							24.0			24.0
Indiana.....							51.3		.4	51.7
Iowa.....	109.7		29.4				7.1		.6	146.8
Kansas.....	99.7	4.2	10.0		3.1		11.9		1.1	129.9
Kentucky.....	3.6									3.6
Louisiana.....			22.6				7.1		.1	29.8
Maine.....			29.9		4.8		10.8		.1	45.6
Maryland.....					11.7		46.0			57.7
Massachusetts.....					12.5		8.6			21.1
Michigan.....			8.5				3.1			11.6
Minnesota.....	11.1									11.1
Mississippi.....	48.3		40.6				5.7	0.5		95.1
Missouri.....	4.5						18.7			23.1
Montana.....	25.2		120.4						.1	145.7
Nebraska.....	53.0	1.8	37.8				.4		1.0	94.0
Nevada.....			42.8							42.8
New Hampshire.....			1.5	.5	3.3		1.0		.6	6.9
New Jersey.....							10.0			10.0
New Mexico.....	11.5		22.5							34.0
New York.....			4.6				132.1			136.6
North Carolina.....							26.1			26.1
North Dakota.....	356.5	9.4	21.7				.7		.4	388.8
Ohio.....	7.6			11.8	5.5		59.8	1.0		85.8
Oklahoma.....	57.4						7.1		.1	64.7
Oregon.....			13.2				9.8			22.0
Pennsylvania.....	9.6						47.8			57.4
Rhode Island.....					4.4	0.9	3.0			8.3
South Carolina.....		17.1							2.2	19.2
South Dakota.....	119.8								.1	119.8
Tennessee.....	12.7		11.8			6.3	5.6			24.6
Texas.....	39.3				6.4		2.5		1.4	61.4
Utah.....			49.4							49.4
Vermont.....							1.5			1.5
Virginia.....	3.9		.2		4.2		2.7			10.9
Washington.....	8.1		10.5				26.7			45.3
West Virginia.....	22.9						16.8		.6	40.3
Wisconsin.....	9.0		72.7				20.9		.2	102.8
Wyoming.....	6.2		4.2							10.4
Total.....	1,098.8	44.4	606.9	12.5	55.9	7.1	632.1	1.5	10.7	2,469.5

TABLE 16.—*Mileage of stage construction completed during fiscal year 1926, by types of construction*

State	Sand-clay	Gravel	Water-bound macadam	Bituminous macadam	Bituminous concrete	Portland cement concrete	Total
California						7.1	7.1
Colorado					1.9		1.9
Georgia		4.2			0.9	15.3	20.4
Idaho		34.2			1.8		36.0
Illinois						0.6	.6
Iowa						12.4	12.4
Kansas	7.0				3.1	9.5	19.6
Kentucky		28.5				5.5	34.0
Michigan						3.9	3.9
Minnesota		135.2				39.7	174.9
Mississippi	.8	35.8					36.6
Missouri		9.3				19.5	28.8
Nebraska		197.9				11.5	209.4
Nevada		5.1					5.1
New Mexico		15.0				.8	15.8
North Carolina			6.8		23.8	30.4	61.0
North Dakota		318.2					318.2
Oklahoma						2.0	2.0
Oregon		7.7					7.7
South Carolina						14.2	14.2
South Dakota		47.4					47.4
Texas				33.3		8.0	41.3
Washington						3.7	3.7
West Virginia				13.0			13.0
Wisconsin		15.5				11.6	27.1
Wyoming		32.8			18.0		50.8
Total	7.8	886.7	6.8	46.3	49.5	195.7	1,193.0

TABLE 17.—*Mileage of projects on which stage construction was in progress on June 30, 1926*

State	Gravel	Water-bound macadam	Bituminous macadam	Bituminous concrete	Portland cement concrete	Brick	Total
Alabama					4.8		4.8
Colorado				6.7			6.7
Georgia		18.8	10.1		31.9		60.8
Idaho				15.5	.2		15.7
Illinois					2.0		2.0
Indiana		11.6					11.6
Iowa	38.9				2.3		41.2
Kentucky	25.5				14.6		40.1
Michigan					25.6		25.6
Minnesota	49.0				49.2		98.2
Missouri	8.2				14.7		22.9
Montana	41.6	4.1					45.7
Nebraska	571.3						571.3
Nevada			15.6				15.6
North Carolina					14.8		14.8
North Dakota	157.3						157.3
Ohio		6.7			5.9	0.8	13.4
Oklahoma					17.4		17.4
South Carolina				14.7			14.7
South Dakota	44.0						44.0
Tennessee					28.0		28.0
Texas		34.1	10.8		16.4		61.3
West Virginia				8.0			8.0
Wisconsin	7.8						7.8
Total	943.6	75.3	36.5	44.9	227.8	0.8	1,328.9

TABLE 18.—*Status of Federal highway system June 30, 1926*

State	Mileage of Federal-aid system approved to June 30, 1926	Federal-aid mileage completed during fiscal year	Federal-aid mileage completed to June 30, 1926
Alabama.....	3, 872. 0	262. 0	1, 415. 7
Arizona.....	1, 498. 0	96. 6	767. 1
Arkansas.....	5, 007. 0	281. 6	1, 418. 5
California.....	4, 574. 4	222. 8	1, 169. 7
Colorado.....	3, 332. 0	84. 5	797. 0
Connecticut.....	835. 4	8. 7	127. 1
Delaware.....	385. 2	8. 6	124. 3
Florida.....	1, 926. 0	36. 9	249. 7
Georgia.....	5, 558. 4	322. 7	1, 975. 5
Idaho.....	2, 768. 6	133. 8	773. 7
Illinois.....	5, 002. 2	182. 4	1, 467. 1
Indiana.....	4, 679. 0	157. 2	687. 2
Iowa.....	7, 212. 0	138. 6	2, 177. 0
Kansas.....	7, 892. 0	269. 1	1, 263. 6
Kentucky.....	3, 701. 0	188. 8	787. 4
Louisiana.....	2, 664. 0	44. 3	1, 069. 8
Maine.....	1, 393. 5	15. 6	303. 6
Maryland.....	1, 479. 2	103. 3	423. 3
Massachusetts.....	1, 308. 0	56. 8	385. 7
Michigan.....	5, 235. 0	134. 1	995. 8
Minnesota.....	6, 849. 6	528. 0	3, 249. 2
Mississippi.....	3, 604. 0	286. 4	1, 158. 9
Missouri.....	7, 530. 0	446. 1	1, 795. 7
Montana.....	4, 661. 0	133. 8	1, 071. 5
Nebraska.....	5, 569. 1	146. 5	2, 021. 2
Nevada.....	1, 398. 0	282. 3	710. 1
New Hampshire.....	977. 4	29. 6	244. 6
New Jersey.....	1, 198. 3	78. 3	307. 9
New Mexico.....	3, 298. 0	137. 5	1, 490. 5
New York.....	5, 018. 0	259. 8	1, 231. 8
North Carolina.....	3, 781. 0	164. 6	1, 343. 1
North Dakota.....	6, 836. 0	260. 4	2, 275. 7
Ohio.....	5, 900. 5	197. 0	1, 422. 6
Oklahoma.....	5, 528. 0	291. 3	1, 201. 5
Oregon.....	2, 814. 0	132. 4	961. 6
Pennsylvania.....	4, 090. 5	447. 6	1, 435. 2
Rhode Island.....	242. 4	23. 5	94. 3
South Carolina.....	3, 230. 0	225. 8	1, 536. 9
South Dakota.....	5, 731. 0	765. 9	2, 345. 8
Tennessee.....	3, 252. 8	238. 8	835. 3
Texas.....	11, 129. 0	723. 5	5, 055. 8
Utah.....	1, 588. 0	135. 2	622. 6
Vermont.....	1, 043. 0	27. 2	135. 2
Virginia.....	3, 075. 5	190. 5	1, 050. 1
Washington.....	2, 907. 7	116. 7	668. 6
West Virginia.....	1, 994. 0	78. 6	414. 5
Wisconsin.....	5, 493. 4	134. 5	1, 619. 1
Wyoming.....	3, 071. 7	187. 3	1, 225. 1
Total.....	182, 134. 8	9, 417. 3	55, 902. 8



TABLE 19.—Federal-aid apportionments to States, expenditures, and balances, as of June 30, 1926

State	Apportionments	Expenditures	Balances unexpended
Alabama	\$14,349,455.00	\$9,919,182.48	\$4,430,272.52
Arizona	9,617,249.00	6,259,140.19	3,358,108.81
Arkansas	11,605,804.00	9,102,538.31	2,503,265.69
California	22,072,815.00	16,120,155.30	5,952,659.70
Colorado	12,325,812.00	8,129,488.18	4,196,323.82
Connecticut	4,333,681.00	2,352,862.75	1,980,818.25
Delaware	2,474,058.00	1,917,078.26	556,979.74
Florida	8,084,954.00	4,849,004.58	3,235,949.42
Georgia	18,431,953.00	15,440,114.91	2,991,838.09
Idaho	8,559,627.00	6,689,044.87	1,870,582.13
Illinois	29,832,198.00	22,546,816.03	7,285,381.97
Indiana	18,204,355.00	13,505,029.08	4,699,325.92
Iowa	19,485,563.00	13,801,842.35	5,683,720.65
Kansas	19,464,411.00	14,672,787.93	4,791,623.07
Kentucky	13,212,809.00	9,910,161.61	3,302,647.39
Louisiana	9,272,408.00	7,033,966.34	2,238,441.66
Maine	6,464,828.00	4,506,120.68	1,958,707.32
Maryland	5,925,057.00	5,146,096.97	778,960.03
Massachusetts	10,108,726.00	6,794,128.62	3,314,597.38
Michigan	20,342,365.00	14,663,354.69	5,679,010.31
Minnesota	19,591,780.00	16,932,876.54	2,658,903.46
Mississippi	12,128,018.00	9,120,178.69	3,007,839.31
Missouri	22,786,436.00	16,797,074.09	5,989,361.91
Montana	13,424,885.00	6,882,815.49	6,542,069.51
Nebraska	14,635,235.00	8,863,931.59	5,771,303.41
Nevada	8,795,215.00	7,493,361.19	1,301,853.81
New Hampshire	3,169,492.00	2,481,613.23	687,878.77
New Jersey	8,467,420.00	6,762,771.79	1,704,648.21
New Mexico	10,972,386.00	7,874,860.93	3,097,525.07
New York	34,045,195.00	20,677,305.80	13,367,889.20
North Carolina	15,717,206.00	12,874,689.22	2,842,516.78
North Dakota	10,748,659.00	6,800,708.71	3,947,950.29
Ohio	25,731,796.00	19,172,556.90	6,559,239.10
Oklahoma	16,059,787.00	13,660,412.30	2,399,374.70
Oregon	10,879,347.00	9,448,016.39	1,431,330.61
Pennsylvania	31,338,781.00	25,427,918.97	5,910,862.03
Rhode Island	2,667,569.00	1,558,829.06	1,108,739.94
South Carolina	9,801,524.00	8,247,733.92	1,553,790.08
South Dakota	11,166,790.00	9,370,161.58	1,796,628.42
Tennessee	15,280,591.00	12,077,084.81	3,203,506.19
Texas	40,606,431.00	31,411,089.08	9,195,341.92
Utah	7,818,779.00	6,028,762.02	1,790,016.98
Vermont	3,268,507.00	2,161,390.47	1,107,116.53
Virginia	13,501,514.00	11,401,105.73	2,100,408.27
Washington	10,145,776.00	8,337,999.77	1,807,776.23
West Virginia	7,352,511.00	5,465,643.81	1,886,867.19
Wisconsin	17,438,815.00	11,306,868.99	6,131,946.01
Wyoming	8,566,274.00	7,235,303.91	1,330,970.09
Hawaii	1,100,153.00	68,556.62	1,031,596.38
Total	671,375,000.00	499,300,535.73	172,074,464.27

### NATIONAL FOREST ROAD CONSTRUCTION

The appropriations for forest road construction are being expended in the several States in which the forests are located on specifically designated systems of forest highways comprising a total of 13,459 miles, of which 11,271 miles are in the 11 States of the Mountain and Pacific groups and the Territory of Alaska.

In all States affected, with the exception of New Mexico and Oregon, the designation of these systems is the result of agreement between the State highway departments, the Forest Service, and the Bureau of Public Roads, and has been formally approved by the Secretary of Agriculture. In the two States mentioned as exceptions final

agreement between the cooperating agencies has not yet been reached and the systems have not been approved by the Secretary, but pending final action work is proceeding upon systems designated by the Bureau of Public Roads.

The highways comprising the systems in the several States are classified according to their character as class 1 highways, which are necessary sections or extensions of the Federal-aid system lying wholly within the forests; class 2 highways which are extensions of the Federal-aid systems extending to towns outside of the forests, and class 3 highways which are largely of local service to communities within the forests.

The mileage of the systems in the several States, classified as above described, is given in Table 20.

TABLE 20.—*Classified mileage of forest highway systems in the several States*

State	Mileage of forest highway system			
	Class 1	Class 2	Class 3	Total
Western:	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>
Alaska.....			316.5	316.5
Arizona.....	174	473	246	893
California.....	312.9	995.6	737	2,045.5
Colorado.....		1,243	527	1,770
Idaho.....		754	347	1,101
Montana.....	145	652	377	1,174
Nevada.....		366	94	460
New Mexico.....	115	211	199	525
Oregon.....	58	872.4	445	1,375.4
Utah.....		415	237	652
Washington.....	18.4	263.7	147.8	429.9
Wyoming.....		380	149	529
Total.....	823.3	6,625.7	3,822.3	11,271.3
Eastern:				
Alabama.....			34	34
Arkansas.....	131	51	20	202
Florida.....	3	13	106	122
Georgia.....			81	81
Maine.....			11	11
Michigan.....			20	20
Minnesota.....		38.5	142	180.5
Nebraska.....			25	25
New Hampshire.....	18.3	15.5	61	94.8
North Carolina.....	49		196	245
Oklahoma.....			33	33
Pennsylvania.....	24.5		166	190.5
South Carolina.....		6	22	28
South Dakota.....	2	153	59	214
Tennessee.....		55	188	243
Virginia.....		28	273	301
West Virginia.....		4	159	163
Total.....	227.8	364	1,596	2,187.8
Grand total.....	1,051.1	6,989.7	5,418.3	13,459.1

<sup>1</sup> System designated by the Bureau of Public Roads not yet approved by Secretary of Agriculture.

It is planned to expend approximately 70 per cent of each annual appropriation for the construction of the highways of classes 1 and 2, which undoubtedly serve the greatest traffic at present, using the balance for the improvement of the class 3, or local forest highways. The administration, survey, and construction of these highways and their maintenance for the first two years, constituting the principal road construction activity conducted independently by the United States Government, has been delegated to the Bureau of Public Roads.

There were 622.5 miles of forest highway projects completed, which, added to the mileage completed previously, bring the total of improved mileage up to 3,045.6 miles, equivalent to 22.6 per cent of the designated systems. The mileage completed in the several States during the year and to date is shown in Table 21.

TABLE 21.—*Mileage of completed forest highway projects by states.*

State	Mileage of forest highway projects completed	
	During 1926	Total to June 30, 1926
Western:	<i>Miles</i>	<i>Miles</i>
Alaska.....	30.7	146.4
Arizona.....	89.2	216.6
California.....	56.4	202.6
Colorado.....	32.1	211.4
Idaho.....	44.4	383.6
Montana.....	66.9	303.3
Nevada.....	9.4	94.2
New Mexico.....	44.3	164.1
Oregon.....	133.5	464.9
Utah.....	16.3	259.0
Washington.....	29.6	184.1
Wyoming.....	39.6	173.8
Total.....	592.4	2,804.0
Eastern:		
Arkansas.....	2.3	56.8
Florida.....	6.2	64.2
Georgia.....		8.6
Minnesota.....	19.4	34.6
New Hampshire.....	2.2	2.2
North Carolina.....		16.4
South Carolina.....		5.3
South Dakota.....		34.8
Tennessee.....		12.2
Virginia.....		6.5
Total.....	30.1	241.6
Grand total.....	622.5	3,045.6

Outstanding among the forest highways recently completed are such noteworthy projects as the Mount Hood Loop road in Oregon, the Prescott-White Spar road in Arizona, the Warm River-Yellowstone road in Idaho, the Smith River Canyon road in northern California, the Neskowin-Siletz River road in Oregon, the Berthoud Pass road in Colorado, the Canoncito-Pecos road in New Mexico, and the Cody-Yellowstone road in Wyoming. For the engineering features involved in their construction and the difficulties overcome these roads are not surpassed in the world.

#### FEDERAL-AID AND FOREST ROAD WORK ASSOCIATED IN WEST

In 1916, when the Federal-aid policy was inaugurated, the States of the mountain and Pacific groups were just beginning systematic highway construction. California had been operating for five years, Washington had made considerable progress, and Colorado and a few of the other States had begun work. The Federal legislation immediately stabilized State highway operations in all of these States and



strengthening legislation has since followed.

The terrain of this western region is characterized by high mountains and broad desert areas. Through and across these mountains and deserts highway construction is expensive and difficult but absolutely necessary to serve the fertile valleys and irrigated semiarid sections in which many people live, as well as to facilitate through transportation between the Mississippi Valley and the west coast.

Of this great western area the national forests occupy approximately 17 per cent, the national parks a fraction of 1 per cent, and the rest of the public domain, including Indian reservations, nearly 30 per cent. These vast nationally-owned and sparsely inhabited areas are so located that they separate the fertile and inhabited sections and must, therefore, be crossed in passing from one community to another. Yet the States in which they lie have no jurisdiction over them, nor power to tax the land for purposes of highway construction; consequently connected highway development would be an impossibility without the cooperation of the Federal Government.

Recognizing this condition, Congress has made appropriations each year since 1917 for the purpose of building roads in and across the forest areas and to towns adjacent thereto. In 1921 it adopted the so-called sliding scale of Federal-aid participation which permits an increase of the normal 50 per cent participation by an amount proportionate in each State to the percentage of unappropriated public land, exclusive of the national forests and parks. The law also permits the Secretary of Agriculture to pay the entire cost of projects in Indian reservations. Thus, by making independent provision for the construction of roads in the forest, park, and Indian reservations, and by increasing the allowable percentage of participation in Federal-aid projects in other parts of these States, the United States has sought to bear its proper share of the cost of supplying the necessary improved highway facilities, not only for its own domain, but, by suitable connection with the State highways, for the entire region.

It follows, therefore, that the forest road construction and the national parks road work for which the United States has made itself solely responsible should be carried on in harmonious relation to the cooperative Federal-aid construction and the unaided construction of the State highway departments. This, happily, is being accomplished

under the present arrangements, whereby the forest road program is determined upon by agreement between the State officials and officers of the two Federal bureaus, and the National Park Service of the Interior Department is cooperating closely with the Department of Agriculture.

Thanks to the sliding-scale provisions of the Federal highway act, highways have been rapidly extended across desolate and almost impassable areas, particularly in the arid Southwest, and the forest road appropriations have permitted the improvement of vital connecting links on transcontinental routes.

Necessarily the forest highway appropriations have taken the heaviest burden because the forests lie in the mountains where topography is rugged, the working season short, and the location remote, all factors which spell high unit costs of construction. Yet, despite these handicaps, prices of 65 and 75 cents a cubic yard for unclassified excavation have not been uncommon.

The improvement of these highways, both the Federal-aid and forest sections, has of necessity been limited in the beginning to first-stage construction, but it has enabled the traffic to pass with increasing safety, speed, and comfort, and the remaining unimproved gaps are being rapidly closed. Meanwhile, as the traffic increases standards of construction are being constantly raised. Grades and curvature are being reduced and widths increased, and projects constructed originally as unsurfaced earth roads are being surfaced.

### HIGHWAY RESEARCH

The physical and economic researches which have been carried on by the bureau for several years have for their purpose the establishment of scientific facts as a means of promoting economy in the expenditure of highway funds. This work, which is regarded as a most important function of the bureau, results each year in the development of information of immediate practical significance and in the accumulation of a mass of detailed observational data which, as its volume grows, is perhaps of even greater value than the immediate benefits.

Among the investigations which have produced results of direct practical application, one of the most important is that which has had for its object the promotion of the efficiency of various operations of road construction. This is a continuation of work which was well advanced during the preceding year.



So far the studies have been confined to operations of earth moving and concrete-pavement construction in which there is perhaps the greatest opportunity for substantial saving.

The method employed in both cases has been the same. The object has been to ascertain and measure the preventable losses of time in construction operations, and this has been accomplished by timing such operations with a stop watch on actual construction projects with histories of progress indicating various degrees of efficiency. The comparatively low average efficiency of current work revealed is not alarming. It is not lower than that which prevails in most construction and manufacturing operations; but the simplicity of the methods which have been developed for the elimination of the various losses is distinctly encouraging and the results that have been obtained when these methods have been applied both by engineers of the bureau and by contractors is very gratifying indeed.

Savings of from 25 to 35 per cent are shown to be generally possible by the earth-moving studies. This result is attained by the selection of the kind of grading equipment best suited to the prevailing length of haul on the project, whether slip scrapers, fresnoes, wheel scrapers, elevating graders, steam shovels, or other type, and by the proper adjustment of the number of units of equipment as the length of hauls varies within the general limits for the job as the work progresses.

The most far-reaching of the indications of these studies is that which points to the desirability of a departure from the practice long employed in the design of railroad and highway grades, of balancing cuts and fills in favor of a design which will render more nearly of uniform length the haul of material from cut to embankment in all parts of the project, and which will reduce the length of haul to a minimum. With a given limiting gradient and rate of curvature and practically without change in the quantity of earth moved it has been found possible to reduce by as much as 20 per cent the cost of grading with an elevating-grader outfit by this method of design in comparison with the older method. This is the saving possible from the change in design alone and does not include the savings which ordinarily may be made on any job by improvements in managerial efficiency.

#### INCREASED OUTPUT IN PAVING

The studies of concrete-paving operations indicate that there are few projects on which the average daily output

can not be increased 25 per cent, and many on which it is possible to obtain increases of 50 and even 100 per cent. The preventable losses in work of this character are mainly the result of maladjustment of material-hauling equipment in number and character to the capacity of the concrete mixer.

By careful elimination of such losses engineers of the bureau have made astonishing increases in the output of working organizations, but more gratifying than these results has been the success which has attended the efforts of contractors, who have made an effort to apply similar methods. In one case of which we have received a report the contractor was able, by his own efforts, to increase the production of pavement from 350 to 600 feet daily; and in another case in the same State the daily footage was increased from 600 to 1,000. Still more gratifying is the fact that on the next contracts obtained by these two contractors, involving 40 miles of concrete pavement, the price bid was \$37,000 less than the normal. Another indication of the effectiveness of the methods is furnished by the fact that on eight jobs recently let, the combined bid of a contractor whose job last season was speeded up by the bureau was \$96,000 below that of the next lowest bidder.

#### THINNER BRICK FOR PAVING

Another investigation that has produced results of immediate value is the study of the relative resistance to traffic of pavements built of five thicknesses of paving brick. For a long time it has been the standard practice in brick-pavement construction to use brick approximately 4 inches thick. Lately in some sections of the country there have been trials of thinner brick, some of them involving the use of brick as thin as  $2\frac{1}{2}$  inches. Although the behavior of these trial sections has been almost uniformly satisfactory, engineers have been reluctant to adopt the thinner brick because of doubt as to their performance under conditions differing from those of the southwestern section in which practically all the trials have been made. Lack of confidence in the ability of the thinner brick to withstand the heavy pounding of truck wheels equipped with non-skid chains has been one of the reasons which have prevented engineers generally from availing themselves of the obvious opportunity to save expense; and this fear has been especially strong in the Northern States in which in winter it is not uncommon for heavy vehicles equipped with chains to be

confined in their operation to a single path by snow ruts. This is perhaps the most severe condition of use to which any pavement is ever subjected.

To resolve these doubts and to determine definitely just what minimum thickness of brick can be expected to give satisfactory service the bureau constructed a circular pavement at Arlington, Va., paved in several sections with brick of 2,  $2\frac{1}{2}$ , 3,  $3\frac{1}{2}$ , and 4 inch thickness. These it subjected to a controlled traffic of motor trucks both with and without chains until the equivalent of 18 or 20 years of normal traffic had been applied. The result is a conclusive proof of the adequacy of  $2\frac{1}{2}$ -inch brick, which will be generally accepted and thus lead to a large annual saving in the cost of brick pavements.

Certain results of the motor-truck-impact tests also have immediate usefulness, especially those which indicate the effect of the kind and condition of tires used. This information should lead at once to the development of tire equipment which will be less destructive to the road surface. In this investigation the bureau has had the hearty cooperation of the Society of Automotive Engineers and the Rubber Association of America, and results of the highest importance to all groups interested have been obtained.

#### IMPORTANCE OF TRAFFIC SURVEYS

Extensive, state-wide surveys of highway utilization have been made in Connecticut, Maine, Pennsylvania, Ohio, California, and Cook County, Ill., and preparations are being made for similar surveys in New Hampshire and Vermont.

The evidence developed by these surveys as to the weight and volume of traffic in all parts of the State highway systems is of the utmost practical importance to the highway authorities of the States. The traffic-flow maps developed present a graphic picture of the relative importance of the various roads included in the system which enables those in charge of highway administration to prepare a really scientific budget and to design with practical certainty the improvement of the various parts of the system, scheduling such improvement in the order indicated by the volume and importance of the traffic.

Not until these surveys were made has any highway official had for his guidance such exact information. In the face of it clashing opinions and political pressure lose their power to sway the course of improvement, and

the highway program is placed solidly upon a scientific basis. This is the immediate result; the less direct benefits which result from the gradual accumulation of basic facts leading to the development of the economic laws of highway transportation are no less important.

What is the economic field of the motor truck? To what degree does it compete with the railroads? To what extent is such competition desirable? What is the economic range of highway travel? What part of the movement is an interstate movement? Is or is not highway improvement actually justified by traffic savings? These and other questions of a similar character demand answers; and the bureau's surveys are supplying the basic facts upon which these answers will finally be formulated. It may almost be said that the bureau and its cooperators alone are carrying on this important work.

Typical of such long-time investigations is the painstaking work that is being done in the study of the characteristics of soils as highway subgrades. The variety of soils is limitless. Uniformity of subgrade support is the aim. How to deal with so wide a variety of materials and produce a condition of uniformity, or failing this, make suitable correction of the pavement or surface is a problem to which there is no hope of immediate solution.

Those who are working in this very important field are urged less by the hope of finding a final solution than by the passion of the scientist for facts. By unremitting careful work they are gradually piling up observation upon observation from the analysis of which a solution will finally be obtained, but of this there is no present prospect. The bureau is a pioneer in this field.

Of similar character are the various researches conducted independently and in cooperation with universities which have for their purpose the measurement of stresses in concrete under impact and static loads and also those resulting from variation in temperature or moisture. Important fundamental facts have been produced by such investigations conducted at Purdue and Johns Hopkins.

A method has been developed by which the load-carrying capacity of concrete pavements can be determined in a few hours by a single field test. Such a test made in Cook County, Ill., demonstrated that the heaviest pavement design provided by the county was just sufficient to carry the heaviest load permitted under the law. A simi-



lar demonstration in another State showed that the design of pavement adopted was not adequate for the loads legally permitted.

There has been a demand from legislators and from designing engineers for information on the relative effect upon the pavement of 6 and 8 wheel trucks and busses in comparison with the usual 4-wheel vehicles. To supply this needed information the bureau undertook and completed a series of tests which have demonstrated that a much larger gross load can be carried on a 6 or 8 wheel vehicle than on a 4-wheel vehicle with no greater harm to the pavement.

One of the outstanding engineering accomplishments of the day is the successful construction of the largest single-span suspension bridge in the world across the Delaware River at Philadelphia. A concrete highway 57 feet wide passes over this bridge. Obviously this concrete floor must be very strong yet comparatively light.

In order to be sure that the 6-inch slab designed for this purpose would be amply strong, the Delaware River Bridge Joint Commission requested the Bureau of Public Roads to make static-load and impact tests on a floor slab identical in design with those of the bridge.

Such tests have been made and have shown that the design which is unusually light and inexpensive is of sufficient strength to carry any load or impact to which it can legally be subjected. Aside from the immediate value of this information there is the more general benefit which will result from the use of this economical design, now proved to be ample, on other bridges.

In an effort to find the cause and suggest a remedy for the disintegration of concrete structures resulting from weather action a comprehensive series of freezing and thawing tests has been instituted, the results of which to date point to the necessity of certain precautions. Such precautions duly taken, it is expected will prevent a considerable loss in highway and other concrete structures.

In some sections of the country it has been necessary to spend hundreds of thousands of dollars to repair damage to highways by landslides. A field study of the conditions surrounding these slides is being made with a view to devising efficient means for their prevention. Already, in some cases, it has been possible to suggest remedies which will probably prevent further trouble.

Another of the important studies now being conducted is that relating to the stability of bituminous paving mixtures. By means of a circular test road on which various mixtures have been subjected to traffic, and by special tests conducted in the laboratory, an effort is being made to discover the laws which govern the stability of the mixtures. The information sought in these studies is of a fundamental nature and it is hoped that it will result in the development of a design for bituminous pavements which will not rut or wave. If successful, this investigation will result in great economies in bituminous pavement construction.

#### COOPERATIVE INVESTIGATIONS

Among the cooperative investigations in which the bureau is working with various universities and State highway departments are several of which the aim is to develop a suitable type of cheap surface for rural highways. At the University of Georgia combined laboratory and field investigations are being made to improve the service value of sand-clay and topsoil roads. The Iowa and South Dakota highway departments are endeavoring to develop a method of improving the service of earth roads by incorporation of lime and Portland cement; and in South Carolina experiments are being made with a view to preserving earth roads by applications of bituminous materials. The importance of these investigations, in view of the fact that millions of miles of roads throughout the country must long remain unpaved, can not be overemphasized.

Other cooperative investigations continued during the year include the tests made by the Iowa State College to determine the tractive resistance of various types of highway surface, those made at the Kansas Agricultural College to measure the wind resistance of automobiles, and those conducted at the University of Kansas for the purpose of measuring tire wear on various surfaces and pavements.

In addition to the research work of which that described is the most important, the bureau also carries on continuously a routine examination of highway materials mainly for the purpose of checking the work and thus controlling the large number of State and commercial laboratories upon whose tests the acceptance of materials used in Federal-aid road construction depends. The results of this work are evident in a general improvement of all laboratories and both Federal-aid and



State-highway construction have benefited by it.

In this connection the bureau has made numerous improvements in testing instruments and apparatus as well as in the methods of testing which have been generally adopted.

#### ORGANIZATION OF THE HIGHWAY FORCE OF THE BUREAU OF PUBLIC ROADS

The organization of the highway force of the Bureau of Public Roads which is responsible for the work reported upon in this report consists of a headquarters staff of eight divisions under the chief of bureau in the Washington office. Three of these, the divisions of design, construction, and bridges, constitute the staff which under the chief engineer and chief of bureau are responsible for the conduct of the Federal-aid and forest-road work. The division of control is responsible for all accounting, for statistics and records, and for investigations dealing with the economy and efficiency of road construction. The division of tests

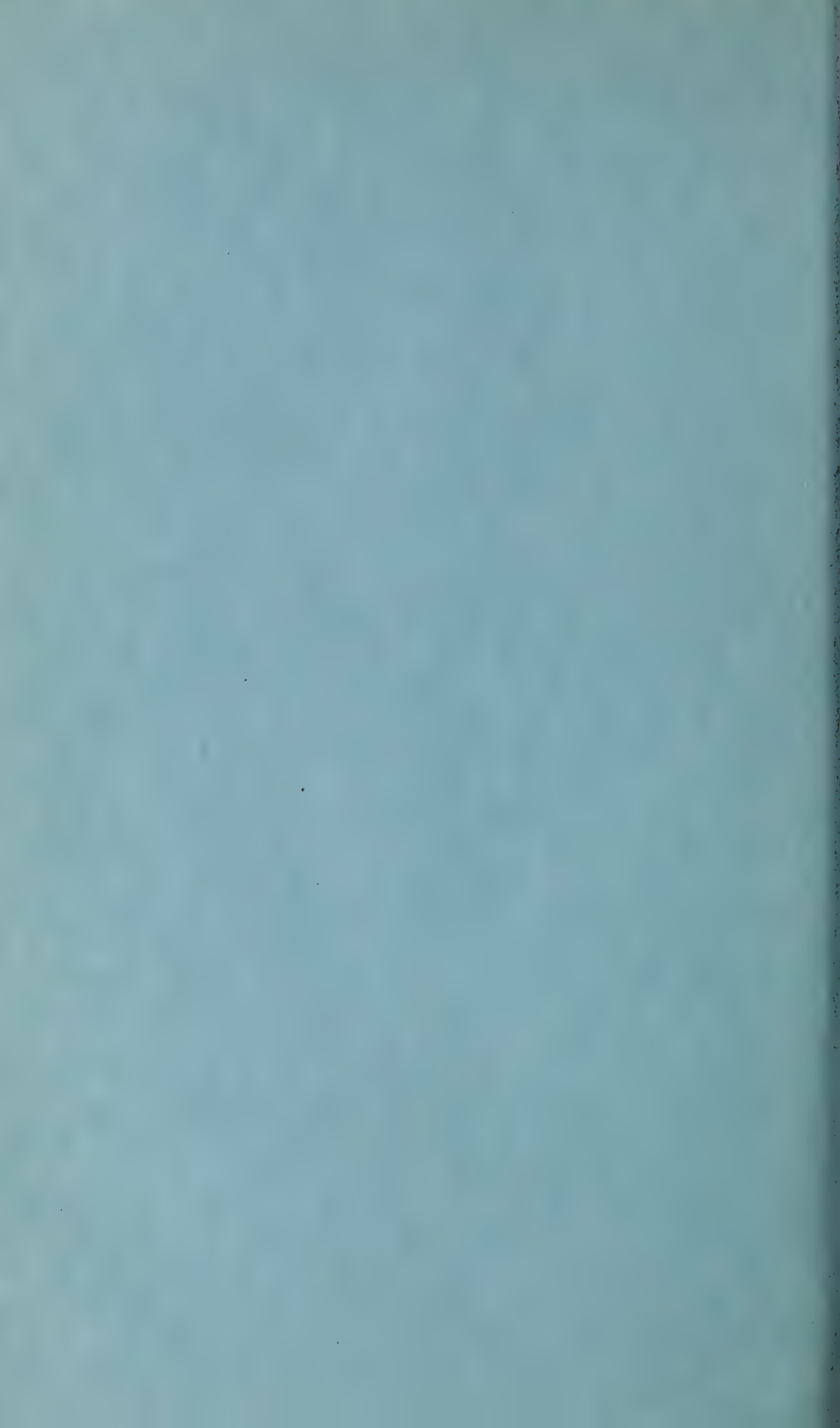
and research carries on all physical researches and makes routine tests of highway materials. The division of highway transportation and economics conducts research along economic lines with particular reference to the economics of highway transportation. In addition there are the legal and editorial divisions performing obvious functions.

In addition to this headquarters staff there is a field force through which direct contact is maintained with the several States in all matters relating to the Federal-aid and forest-road work. This force is headed by 11 district engineers with offices in Troy, N. Y.; Washington, D. C.; Montgomery, Ala.; Chicago, Ill.; St. Paul, Minn.; Omaha, Nebr.; Fort Worth, Tex.; Denver, Colo.; Ogden, Utah; Portland, Oreg.; and San Francisco, Calif. The eight eastern districts report directly to the chief engineer at Washington; those with headquarters in Denver, Portland, and San Francisco report to the deputy chief engineer, whose headquarters are in San Francisco, and through him to the Washington office.









OF EXPERIMENT STATIONS  
Tuesday, November 30, (morning)

EC 14 Soils

EXPERIMENT STATION FILE

# ANNUAL REPORT OF THE CHIEF OF THE BUREAU OF SOILS FOR 1926

UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
Washington, D. C., August 31, 1926.

SIR: I have the honor to submit the following report covering the operations of the Bureau of Soils for the fiscal year ended June 30, 1926.

Respectfully,

MILTON WHITNEY,  
Chief of Bureau.

Hon. W. M. JARDINE,  
Secretary of Agriculture.

The work of the Bureau of Soils, outside of the mechanics involved in the mapping of soils, consists chiefly of the investigation and study of soil types, research in pure soil science, and investigation of fertilizer resources; namely, Soil Survey, Soil Chemistry, Soil Physics, and Fertilizer Resources. Reports covering these four divisions for the fiscal year ending June 30, 1926, follow:

## SOIL SURVEY DIVISION

### THE SOIL SURVEY

During the fiscal year 75 projects were begun or completed, in 29 States. In each case the work was done in

cooperation with some State organization. The total area surveyed in these projects aggregates 24,219 square miles or 15,500,160 acres. Two reconnaissance surveys were made, one in Minnesota and the other in Montana, covering 4,289 square miles or 2,744,960 acres.

The grand total area covered by detailed surveys from the inception of the work to, and including June, 1926, aggregates 708,670 square miles or 453,548,800 acres. The reconnaissance surveys total 574,262 square miles or 367,527,680 acres. The following tables show the areas surveyed during the fiscal year and the total area surveyed in each State up to the present time.

TABLE 1.—Individual areas surveyed and mapped during the fiscal year ended June 30, 1926

#### DETAILED SURVEY

State	Area	Area surveyed		State	Area	Area surveyed	
		Square miles	Acres			Square miles	Acres
Ala...	Franklin County.....	1 138	88,320	Fla...	Polk County.....	699	447,360
	Montgomery County.....	1 411	263,040	Ga....	Bartow County.....	1 213	136,320
Ariz...	Salt River Valley area...	1 187	119,680		Lamar County.....	161	64,640
Ark...	Clay County.....	164	104,960		Lee County.....	118	75,520
Calif...	Chico area.....	1 341	218,240		Quitman County.....	144	92,160
	Oroville area.....	501	320,640		Wayne County.....	1 358	229,120
	Placerville area.....	51	32,640	Idaho...	Soda Springs-Bancroft area.	1 302	193,280
Colo...	Lower Arkansas Valley area.	1 96	61,440	Ind...	Dubois County.....	176	112,640

<sup>1</sup> These figures do not include portions of these areas surveyed in preceding years.

TABLE 1.—Individual areas surveyed and mapped during the fiscal year ended June 30, 1926—Continued  
DETAILED SURVEY—continued

State	Area	Area surveyed		State	Area	Area surveyed	
		Square miles	Acres			Square miles	Acres
Ind...	Hancock County.....	1 210	134, 400	N. Y..	Erie County.....	1 493	315, 520
	Miami County.....	71	45, 440		Suffolk County.....	332	212, 480
	Putnam County.....	1 212	135, 680	N. C..	Burke County.....	267	170, 880
Iowa..	Carroll County.....	82	52, 480		Lenoir County.....	209	133, 760
	Chickasaw County.....	74	47, 360		Nash County.....	586	375, 040
	Howard County.....	1 382	244, 480	Ohio..	Rockingham County.....	1 340	217, 600
	Kossuth County.....	1 874	559, 360		Lake County.....	1 177	113, 280
	Lyon County.....	116	74, 240		Muskingum County.....	1 93	59, 520
Kans..	Warren County.....	1 486	311, 040		Scioto County.....	349	223, 360
	Clay County.....	1 199	127, 360	Oreg..	Washington County.....	429	274, 560
	Labette County.....	583	373, 120		Eugene area.....	1 548	350, 720
	Wilson County.....	69	44, 160		Grande Ronde Valley area.....	76	48, 640
La....	Beauregard Parish.....	312	199, 680		Marion County.....	299	191, 360
Md....	Harford County.....	77	49, 280	S. D..	Brown County.....	1 216	138, 240
	Prince Georges County.....	1 131	83, 840		Hyde County.....	1 720	460, 800
Mass..	Dukes-Nantucket Counties.....	162	103, 680		Moody County.....	135	86, 400
	Essex County.....	497	318, 080	Tenn..	Hardin County.....	1 141	90, 240
Mich..	Chippewa County.....	207	132, 480	Tex..	Milan County.....	1 210	134, 400
	Kent County.....	1 462	295, 680		Nacogdoches County.....	1 401	256, 640
	Menominee County.....	1 978	625, 920		Navarro County.....	439	280, 960
	Tuscola County.....	451	288, 640		Van Zandt County.....	259	165, 760
Minn..	Washenaw County.....	554	354, 560		Victoria County.....	241	154, 240
	Mille Lacs County.....	131	83, 840	W. Va.	Willacy County.....	443	283, 520
	Wadena County.....	1 212	135, 680	Wis..	Monroe County.....	457	292, 480
Miss..	Claborn County.....	489	312, 960		Calumet County.....	324	207, 360
	Rankin County.....	1 186	119, 040		Manitowoc County.....	312	199, 680
Nebr..	Custer County.....	1 452	929, 280	Wyo..	Trempealeau County.....	214	136, 960
	Keith County.....	127	81, 280		Wheatland area.....	203	129, 920
	Lincoln County.....	1 107	690, 560		Total.....	24, 219	15, 500, 160
	Suckolls County.....	1 213	156, 320				
N. J..	Camden area.....	1 228	145, 920				

<sup>1</sup> These figures do not include portions of these areas surveyed in preceding years.

TABLE 2.—Areas surveyed and mapped in the several States during the fiscal year ended June 30, 1926, and the areas previously reported

DETAILED SURVEY

State or Territory	Work during 1926 (square miles)	Work previously reported (square miles)	Total		State or Territory	Work during 1926 (square miles)	Work previously reported (square miles)	Total	
			Square miles	Acres				Square miles	Acres
Ala.....	549	50, 584	51, 133	32, 725, 120	N. H.....	1, 411	1, 411	903, 040	
Ariz.....	187	1, 983	2, 170	1, 388, 800	N. J.....	228	9, 667	6, 333, 800	
Ark.....	164	15, 383	15, 547	9, 950, 080	N. Mex.....		596	596	381, 440
Calif.....	893	26, 029	26, 922	17, 230, 080	N. Y.....	825	24, 190	25, 015	16, 009, 600
Colo.....	96	3, 354	3, 450	2, 208, 000	N. C.....	1, 402	37, 577	38, 979	24, 946, 560
Conn.....		1, 704	1, 704	1, 090, 560	N. Dak.....		16, 878	16, 878	10, 801, 920
Del.....		2, 276	2, 276	1, 456, 640	Ohio.....	1, 048	12, 104	13, 152	8, 417, 280
Fla.....	699	13, 253	13, 952	8, 929, 280	Okla.....		6, 540	6, 540	4, 185, 600
Ga.....	934	30, 739	31, 673	20, 270, 720	Oreg.....	923	11, 697	12, 620	8, 076, 800
Idaho.....	302	9, 516	9, 818	6, 283, 520	Pa.....		16, 721	16, 721	10, 701, 440
Ill.....		6, 770	6, 770	4, 332, 800	P. R.....		330	330	211, 200
Ind.....	669	15, 311	15, 980	10, 227, 200	R. I.....		1, 085	1, 085	694, 400
Iowa.....	2, 014	36, 348	38, 362	24, 551, 680	S. C.....		23, 062	23, 062	14, 759, 680
Kans.....	851	9, 559	10, 410	6, 662, 400	S. Dak.....	1, 071	6, 823	7, 894	5, 052, 160
Ky.....		5, 020	5, 020	3, 212, 800	Tenn.....	141	11, 057	11, 198	7, 166, 720
La.....	312	15, 597	15, 909	10, 181, 760	Tex.....	1, 993	44, 558	46, 551	29, 792, 640
Me.....		2, 197	2, 197	1, 406, 080	Utah.....		2, 419	2, 419	1, 548, 160
Md.....	208	11, 311	11, 339	7, 256, 960	Vt.....		1, 175	1, 175	752, 000
Mass.....	659	6, 234	6, 893	4, 411, 520	Va.....		9, 713	9, 713	6, 216, 320
Mich.....	2, 652	14, 818	17, 470	11, 180, 800	Wash.....		10, 752	10, 752	6, 881, 280
Minn.....	343	7, 796	8, 139	5, 208, 960	W. Va.....	457	19, 365	19, 822	12, 685, 080
Miss.....	675	28, 133	28, 808	18, 437, 120	Wis.....	850	22, 063	22, 913	14, 664, 320
Mo.....		37, 177	37, 177	23, 793, 280	Wyo.....	203	855	1, 058	677, 120
Mont.....		882	882	564, 480					
Nebr.....	2, 871	41, 367	44, 238	28, 312, 320	Total.....	24, 219	684, 451	708, 670	453, 548, 800
Nev.....		652	652	417, 280					



TABLE 2.—Areas surveyed and mapped in the several States during the fiscal year ended June 30, 1926, and the areas previously reported—Continued

## RECONNAISSANCE SURVEY

State or Territory	Work during 1926 (square miles)	Work previously reported (square miles)	Total		State or Territory	Work during 1926 (square miles)	Work previously reported (square miles)	Total	
			Square miles	Acres				Square miles	Acres
Alaska.....		31,915	31,915	20,425,600	Ohio.....		41,420	41,420	26,508,800
Ark.-Mo.....		58,000	58,000	37,120,000	Pa.....		41,405	41,405	26,499,200
Calif.....		32,135	32,135	20,566,400	S. Dak.....		41,400	41,400	26,496,000
Kans.....		39,960	39,960	25,574,400	Tex.....		132,735	132,735	84,950,400
Mich.....		1,322	1,322	846,080	Wash.....		16,540	16,540	10,585,600
Minn.....	445	1,352	1,797	1,150,080	Wis.....		14,425	14,425	9,232,000
Mont.....	3,844	25,060	28,904	18,498,560	Total.....	4,289	569,973	574,262	367,527,680
Nebr.....		53,064	53,064	33,960,960					
N. Dak.....		39,240	39,240	25,113,600					

A soil survey has been started on an area around Placerville, Eldorado County, Calif., covering an important pear-growing district in the foothills of the Sierra Nevada. Soil-type studies here indicate a close correlation with the soils in important prune, nut, and berry producing districts in Oregon. Facts will be gathered from this survey that will aid in the identification of lands suitable for the extension of the pear-growing industry, and of soils unadapted for intensive fruit culture but which may be utilized in forestry and for grazing.

A survey was made of an area in southeastern Idaho, covering an important general farming and livestock region, in Bannock and Caribou Counties. This survey has given information regarding the distribution and development of the soils comprising the eastern extension of the great area of loessal soils of the Northwest not previously known. The immediate and practical results of the survey lie in the fact that the facts disclosed in the survey tend to discourage the promotion of a proposed irrigation district in the northwestern part of the surveyed area, where the soils are shallow and of irregular topography adverse to economical irrigation, and where the cost involved in the distribution of the water and in providing for necessary drainage would be comparatively high.

A survey of over 1,200 square miles was made in Oregon, including the southernmost part of the Willamette Valley and adjacent hill lands. The undeveloped hill lands include large areas of soils that are similar to those found in other areas adjacent to the Willamette Valley, which are utilized

in the production of prunes, walnuts, and small fruit.

In a survey of the Salt River Valley area, Arizona, a number of soil types were identified which will encourage a more extensive production of lettuce, cantaloupes, and early potatoes. This survey has brought under observation interesting individual accomplishments in the reclamation and improvement of some of the low-lying valley lands which naturally were badly affected by very poor drainage and alkali. These reclaimed lands now produce alfalfa, and are used in dairying and livestock farming.

A number of soil series and types not previously recognized were mapped in the Chico area, California. Some of these have decidedly calcareous subsoils, a condition which the survey indicates is closely associated with a serious physiological trouble experienced for the past several years in prune orchards, locally known as "die-back," which is causing the removal of formerly productive orchards. This is a severe blow to agriculture in this area, since this region is one of the more important prune-growing districts of the State. Results of this observed correlation of soils with "die-back" have been brought to the attention of the University of California, which is cooperating in the survey. Extensive field and laboratory studies are now being prosecuted by a corps of State specialists. It is believed that the field observations made in this survey will furnish a clue which will lead to the discovery of the cause of the difficulty and of a means for prevention or control.

The correlation observed between soils and "die back" in the Chico

area will obtain to a less extent in the Oroville area which joins the Chico area on the south. Extensive areas of foothill lands, now being developed for citrus fruits, are included in this latter survey. In the Oroville area occur soils which are wholly unadapted for, or not well suited to, fruit growing, owing to their shallow depth.

#### STUDIES OF TROPICAL SOILS

During the year the cooperative arrangement with the Tropical Plant Foundation for the study of the soils of Cuba was continued. The results, not yet published, have unquestionably justified the efforts. It is believed that the knowledge thus obtained will prove of great help in classifying soils and in improving crop production on the island through a better knowledge of soil type and cane relations.

The work in Cuba has given the opportunity for studying in detail the characteristics of the soils of the famous Vuelta-Abajo cigar-tobacco district. It was learned that the finest quality of leaf is grown on sandy and gravelly soils of a highly quartzose nature. Some of these soil types correspond closely to the Greenville and Orangeburg fine sandy loams of the Atlantic and Gulf coastal plains. On the heavier soils of Cuba, namely, the red, brown, and black clays of the Partito and Vuelta-Arriba districts, is produced a leaf of lower value, that grown on the red lands of the Partito having the lesser value.

In the cane-producing sections some very important studies were made of the salt content of certain clays having peculiar, dense subsoils. In some of these soils the distribution of salt was found to be essentially the same from the surface down deep into the subsoil, indicating that removal of the salt by artificial drainage would be practically impossible, and that the best use to which the excessively salty areas of these soils may be put would be to use them for pasture.

In Cuba clay soils were found in close association having subsoils differing distinctly in structure of material, differences which should determine the proper cultural methods for increasing the producing power of these lands.

So greatly diversified are the soils of Cuba that it has been found to be practically meaningless to discuss agricultural conditions except in connection with soil types. The famous "red land" has been found to consist of at least six extremely divergent

types of red soils, differing widely in producing power and requiring widely different methods of management.

Agricultural conditions in Cuba could be much improved if only the better soils were used in cane production and if better methods of cultivation and fertilization were more generally practiced.

On the Isle of Pines, which has so often been described as an isolated bit of Florida, it was found that the soils resemble those of Florida only in the surface layers, both regions having considerable light-colored sandy lands. On the Isle of Pines most of the soils have developed from schist rocks, often highly quartzose. The resultant soils are extremely gravelly in places. Some of these soils are well suited to citrus fruits and vegetables, but they must be liberally fertilized with complete chemical fertilizers.

Studies of tropical soils have disclosed some very interesting soil properties, such as high friability, low shrinking and swelling qualities, excellent porosity and strong resistance to erosion. It has been shown that these properties are associated with clay soils having a low molecular ratio of silica to iron oxide plus alumina, and that opposite properties are generally associated with clays which have much higher ratios of these sesquioxides. In studying these properties it has been learned that certain soils in southern United States are much like those peculiar, friable, tropical soils which have undergone advanced weathering. This applies to the clay soils of the Nacogdoches series in the eastern part of Texas and of the Cecil and Mecklenburg series in the Piedmont region. Since the clays which possess the properties indicated by a low ratio of silica to iron plus alumina are probably the best to meet the requirements of good highway subgrade material, the relation of this ratio to soil characteristics may prove of value in connection with highway engineering.

These investigations have considerably changed the conception of the properties of clay soils. For example, certain clay soils of extremely fine composition are very much more friable than clay soils of a much lower clay content.

#### SOIL STUDIES IN COOPERATION WITH FEDERAL AGENCIES

Soil studies were continued in cooperation with the Reclamation Service in the classification of agricultural lands, and with the Forest Service,



Indian Service, Bureau of Public Roads, and the Bureau of Plant Industry.

In cooperation with the Bureau of Public Roads, field investigations were made of the relation of certain soil types to highway subgrades. In southeastern Ohio it was found that hillside slipping of masses of soil and subsoil material in the extensive area of Upshur soils of that region had completely demolished sections of recently laid concrete roads. In one instance near Marietta, a slide had displaced several hundred feet of concrete to the extent of projecting it into the valley below, utterly destroying the expensively built road.

It was found that many hillsides of Upshur soil, from the bottom to the top, were in process of sliding. This has continued to such an extent that a peculiar steplike topography has developed throughout the region occupied by these peculiar chocolate-red Upshur soils which are so prominently distributed throughout southeastern Ohio, southwestern Pennsylvania, and many parts of West Virginia. In view of the fact that the slipping is a continuing process that may never stop under natural conditions, the problem seems to be one which will demand very serious attention from highway engineers.

It is impossible, with the studies thus far made, to define the physical properties of these Upshur soils which cause them to slide. This problem requires further investigation. It is known that the rock strata beneath the Upshur soils for several feet are generally soft and of weak character, due partly to their natural make-up and partly to the results of weathering.

In Texas a section of highway in the black waxy belt was examined by one of the bureau's soil experts, and suggestions were submitted to the Bureau of Public Roads in regard to special treatment of the subgrade.

It was pointed out that the black clay of the region might prove to be not the best class of material upon which to lay hard surfacing, inasmuch as it greatly swells and shrinks at the extremes of moisture content. It was advised that other available material, such as soil material least subject to excessive swelling and shrinking, be used in the subgrade.

#### INTENSIVE FIELD INVESTIGATIONS OF SOIL TYPES

The following two facts have been gathered from special studies made of

the soils of southeastern Ohio and adjacent areas in Pennsylvania: (1) The DeKalb family of soils formed from the weathering of the light-colored, nonlimy shales and sandstones are prevalently acid in character, and (2) the associated red soils of the Upshur group of soils are neutral or alkaline in reaction. The former soils respond readily to applications of lime. The Upshur soils, on the other hand, are generally not in need of lime, and they usually support fair to good bluegrass without any special treatment.

An investigation of the soils in the Rio Grande region, in their relation to citrus fruits and other crops, showed that the alkali areas are the poorly drained soils. These poorly drained, alkali soils contain excessive quantities of salt, while other soils bordering the alkali areas seldom contain salts in harmful quantities.

Studies were made of the major groups of soils occurring in the Middle West. In these investigations special attention was given to the relation between the characteristics of the soil layers and the different climatic conditions under which these soils have developed. From such studies valuable contributions are made to soil science.

Intensive field studies were made of the Carrington, Miami, Crosby, Brookston, and Clyde silt loams of north-central Indiana. From these studies much valuable data were gathered that will aid materially in solving some of the problems in soil classification.

A study was made of the possibilities of colored photography in the field investigation of soil types. Photographs were taken of the profiles of many of the more important soils of southeastern United States. It is remarkable how distinctly the various colors, mottlings, and streaks, show on the plates. This was the first attempt at soil color photography. The results are highly satisfactory.

#### SPECIAL SOIL STUDIES IN COOPERATION WITH STATES

The South Carolina Experiment Station recently requested the assistance of this bureau in locating an experimental branch station on typical Norfolk sand in the sandhill region. This sandhill belt begins just south of Sanford, North Carolina, extends across South Carolina, and, in a more narrow belt, across Georgia, and terminates in Lee County, Ala. In this belt the soils are composed



largely of sand and are naturally deficient in the elements of plant food. This belt, for the most part, is undeveloped, agriculturally. The growing of peaches and dewberries in certain localities has recently suggested agricultural possibilities in this belt. Thus, the purpose of the experiment station or test farm is to study these sandy soils with a view to making them profitably productive.

In cooperation with North Carolina, an investigation was made of the soils in the vicinities of Aberdeen, Pinehurst, West End, Candor, Hoffman, and other places with a view to determining, if possible, the cause of the dying of quite a large number of 8-year-old and 10-year-old peach trees during the last two years. A thorough examination of the soil from the surface downward to depths of from 9 to 11 feet was made in several orchards, in areas where the trees were dead and in other areas where the trees presented a healthy appearance. It was thought that possibly some detrimental soil characteristic was a factor in causing the trees to die. Results of the investigations thus far seem to show that the soil is not the chief factor involved.

### SOIL TECHNOLOGY

The results of a special study of soil types in relation to productivity were prepared and published as Department Bulletin No. 1377. This study consisted of a critical investigation of the results of all the long-continued fertility experiments in progress in the United States and England, a study never before made. The results of this investigation point to the following principles of permanent soil productivity:

1. Crop rotation rivals the use of complete commercial fertilizers and farm manure in maintaining and increasing the yields of cereal crops.

2. The conjoint effects of crop rotation and the use of fertilizers are additive, as effecting increases in crop yields.

3. The beneficial effects of crop rotation are greater on soils naturally supplied with lime and on soils whose reactions have been altered or changed by liming than on soils that are acid in character.

A Farmers' Bulletin, No. 1475, based on the results presented in Department Bulletin No. 1377, was prepared and published. In this bulletin are dis-

cussed the principles which underlie proper rotations.

An intensive field study was made of five dominant soil types of north-central Indiana, in their relation to crop production. The results of this study have been written up and presented for journal publication.

### OTHER SERVICES AND ACTIVITIES

The bureau has rendered valuable services to banks and land appraisers in aiding them to determine land values, as based on the soil surveys. Since the agricultural depression of 1921 the banks and loan companies interested in placing farm loans in the Middle West, or in financing industries which depend on agricultural prosperity, have been trying to gain more exact information concerning land values. This information was particularly desired by the Federal farm loan banks. It was felt that more use should be made of the work done by the soil surveys. During the past year farm-loan bankers and appraisers met at Iowa State College and the University of Nebraska and requested these institutions to give them short courses including a field study of soils. During the conferences information was given them regarding the soils of the respective regions, and they were instructed how to read and use the soil maps and reports and in the identification of soil types. The result has been an increased use of the soil-survey reports in land appraisal.

The Soil Survey prepared an exhibit for the Sesquicentennial Exposition at Philadelphia, showing the characteristics of the great soil families in the United States. The exhibit consists of 16 units, each designed to show the characteristics of a family of soils, or an important subdivision of a family, as they occur in the field to a depth of 5 feet, including soil, subsoil, and in some instances parent material. This is the first exhibit in which the Soil Survey has been able to show, by means of cross sections of natural soils, the typical characteristics of some of the dominant soils of the country in their mature stage of development.

The Soil Survey continues to receive many inquiries regarding the identification of soil types, and much information has been given relative to the suitability of soil types for the growing of various crops and to methods for increasing their producing power.

## SOIL CHEMISTRY DIVISION

The activities of the chemical division have been pursued along three general lines; namely, special soils have been analyzed to assist in the classification of soils by the Soil Survey, investigations have been conducted on the composition and properties of soils in general, and soils have been examined for other Government agencies and for individual farmers.

These three divisions of the work are interrelated. Studies of soils in general often disclose facts which are of great value to the Soil Survey in making field studies of special soil types. For instance, the study of the colloidal material in soils is giving new information concerning soil types and suggesting new methods for their examination. Furthermore, in the examination of special soils principles may be discovered that are fundamental in soil science.

### CHEMICAL WORK

In connection with the work of the soil survey complete chemical analyses by the fusion method have been made of the different strata of which soil types are composed, from the surface downward. The difference in chemical composition which obtains between the various soil strata is one of the more important criteria for differentiating soil types. During the past year a number of such analyses have been added to those accumulated in past years, until now sufficient information is in hand to establish some of the distinguishing chemical characteristics of broad groups of soils in the United States.

Analyses of soil strata by the fusion method show only differences in the total quantity of elements in the various soil strata. To gain a deeper insight into the chemical characteristics of a soil from the surface downward, it is necessary to know how the elements are combined in the different strata. An investigation of this subject has been in progress for some time. During the past year additional determinations were made of the kinds and quantities of the soil-forming minerals and colloidal material present in soil strata down to parent rock. Such data should not only bring to light the fundamental chemical differences in the soil layers, but should also give information concerning the decomposition of soil minerals and the development of soil types. Comparatively little work has been done in this field

of investigation; hence it has been found necessary to investigate some questions which are subsidiary to the main problem. For example, in the course of this work it was necessary to have information concerning the alteration of mica in the soil before it disappears as mica. Data bearing on this question were obtained, and the results of the study are being prepared for publication. It seems that the mica particles which may occur in a soil may be quite different in composition from fresh mica and that the alteration in chemical composition takes place in that zone of rock weathering where the hard rock begins to disintegrate.

### INVESTIGATION OF SOIL COLLOIDS

In the study of the properties of the different soil colloids gratifying progress has been made. A report of recent investigations on this subject is given in a bulletin which is now in press. Previous publications have shown the extent to which colloidal materials of different soils may vary in chemical composition and adsorptive power. The more recent investigation concerns many of the properties of these soil colloids, such as electrical charge and size of particles, which are characteristic of other colloidal materials. It was found that if a certain kind of soil colloid varies from another in one property it usually shows a similar variation in all other properties, and that differences in properties of soil colloids show a correlation with differences in their chemical composition. The behavior of a soil colloid may, therefore, be fairly well indicated by its chemical analysis or by the degree to which it possesses one or two properties.

Since the kind of colloidal material in a soil determines to a considerable degree its productivity, it is obviously important to determine the kinds of colloids present in the various soil types. It seems, from the present investigation, that if a sample of the colloidal material is isolated from a soil, a fairly complete characterization of it may be obtained by determining its content of silica, iron, and alumina, and its adsorptive capacity for cations and water vapor. Apparently, an approximate estimation of the kind of colloid a soil contains may be obtained without isolating the pure colloid from the soil. It has been found that the quantities of water vapor adsorbed by a sample of whole



soil when placed over 3.3 per cent and 30 per cent sulphuric acid will show, respectively, the quantity and kind of colloid present in a soil.

The results of these studies of the properties of colloids throw light upon the relation between soil colloids and other colloidal materials which have been investigated much more exhaustively. As a class, the soil colloids seem to be related more nearly to the lyophobe than to the lyophile colloids, although materials isolated from some soils approach lyophile colloids in their ability to swell. Soil colloids differ from many artificial colloids in showing a high adsorptive capacity for both vapors and electrolytes. According to current theory, this would indicate that they have, when dry, a structure similar in fineness to that of silica gel and activated charcoal, and that they possess considerable activity of a more strictly chemical nature.

Information concerning the condition of the monovalent and divalent bases in the colloidal material was obtained in studying the behavior of the material in cataphoresis and electrodialysis experiments. Detailed reports of these studies are being published. When the colloidal soil material is subjected to electrodialysis, nearly all the calcium is removed, whereas only comparatively small portions of the magnesium and potassium are removed in this manner. The quantities of these three bases removed by the electric current are practically the same as those removed by treatment with salt solutions. Inasmuch as only small portions of the magnesium and potassium are removed, it would seem that these two elements are present in two conditions, and that in one condition they are much more reactive than in the other. The electrical charges assumed by colloidal particles when suspended in water seem to be due to the removable or reactive portions of the monovalent and divalent bases. Only fractions of the bases that are removable are probably present as ions.

#### RESEARCH IN SOIL ORGANIC MATTER

A study was made of the decomposition of soil organic matter by the use of hydrogen peroxide. It was found that the organic matter in certain soils was almost completely destroyed by the procedure adopted. Other soils, however, contained considerable organic matter that was most resistant to oxidation. Apparently charcoal and charcoallike material is more

widely distributed in soils than has previously been supposed.

#### OTHER ANALYTICAL WORK

A large number of soil samples were examined for other branches of the Government and for individual farmers, and desired information given. In some cases these samples were handled expeditiously by petrographic methods that had previously been developed in the bureau. In other cases the desired information could not be given without first conducting an investigation which it was impossible to undertake with the present restricted personnel.

#### SOIL PHYSICS DIVISION

The fact that the productivity of a soil is affected in a large measure by its physical condition emphasizes the importance of investigating the physical characteristics of soils, to aid in classifying them and in finding out what physical properties are most desirable for high yields. In this connection, the determination of the physical composition of a soil is of prime importance. Thus, the physical division has continued the investigation of methods for mechanical analysis. In studying different methods there has been cooperation with several foreign soil investigators in an effort to establish a standard method so that the results obtained in different countries may be compared. The effort has been to shorten the time required in making an analysis and to obtain greater accuracy in the analyses. Although the investigation is not complete, several difficulties have been overcome and improvements have been made in the methods now in use.

The determination of certain physical properties of soils in their field condition has been undertaken. Since no satisfactory methods existed for such examinations, several new methods have been worked out during the year and a number of soil types examined by their use. Information has been obtained that will be useful in the description and classification of soil types.

Studies of the relation of soil temperature to atmospheric temperature have been continued, with special attention being given to the effect of shading the soil. The records of the results of two years are now being tabulated, and will furnish data upon which it may be possible to base treatment for the partial control of soil temperature.



Many hundreds of soil samples, gathered from different agricultural sections of the United States, have been analyzed to determine their mechanical composition. These analyses, together with the determinations of moisture equivalent made on a similar number of samples, have furnished data showing the physical make-up and the moisture retentiveness of the soils. The results of such analyses throw more light upon the question of what the fundamental principles are underlying crop adaptation, water retentiveness, and water-supplying ability of soils.

The division has also constructed and repaired special apparatus and instruments for use in the bureau, in some instances saving thereby hundreds of dollars that it would have been necessary, otherwise, to expend in the purchase of new equipment.

### FERTILIZER RESOURCES DIVISION

The work of the Fertilizer Resources Division covered projects concerned with concentrated fertilizers, phosphates, potash, organic nitrogen, and miscellaneous soil amendments.

### CONCENTRATED FERTILIZERS INVESTIGATIONS

In last year's report an outline was given of methods that have been developed for the preparation of such concentrated materials as ammonium phosphate, potassium phosphate, and potassium nitrate. Improvements in these methods have since been made, and the study of the properties of these and other concentrated fertilizer materials, such as urea and ammonium nitrate, is in progress.

Field tests with concentrated fertilizer mixtures were begun last year by the Soil Fertility Division of the Bureau of Plant Industry. A large number of different mixtures used in these tests were prepared for use in the concentrated fertilizer laboratory. The materials used in these mixtures were selected so as to make a direct comparison of the fertilizing value of such fixed-nitrogen products as urea, ammonium nitrate, and ammonium chloride, and of such new phosphatic materials as ammonium phosphate and triple superphosphate.

Experiments were started, in cooperation with the division of agricultural engineering, Bureau of Public Roads, with a view to determining the drillability of a large number of concentrated fertilizer materials and mix-

tures in comparison with the ordinary mixed fertilizers. The experiments, made under known conditions of temperature and humidity and with the ordinary farm machinery, show which fertilizer mixtures can be applied with present farm equipment and which can not be so applied. From such tests much information is gained regarding the tendency to cake which many fertilizers exhibit, and the effectiveness of any special treatment for reducing the caking of fertilizers. It has been found that excellent results may be obtained in reducing the tendency of fertilizer salts to cake (1) by different processes of granulation, (2) by mixing certain compounds which tend to form double salts, and (3) by diluting with certain water-insoluble materials such as the organic ammoniates.

Important improvement in the official method for the determination of phosphoric acid in fertilizers has been made as a result of a collaborative study undertaken at the suggestion of the Association of Official Agricultural Chemists. In connection with this work standard phosphate samples were prepared and sent to a number of fertilizer chemists, both in this country and abroad.

An exhibit of fertilizer samples and of working models to show methods of preparing new fertilizer materials and the beneficial effects of granulating hygroscopic fertilizer salts was prepared for the chemical exposition held in New York, September 28 to October 3, 1925. A similar exhibit, but with different models, was also prepared for the Sesquicentennial Exposition in Philadelphia.

### PHOSPHATE INVESTIGATIONS

The work on the phosphate project for the fiscal year ending June 30, 1926, as in the previous year, was largely concerned with investigations relative to the production of phosphoric acid by volatilization processes.

In previous reports it has been pointed out that phosphorus may be completely volatilized from phosphate rock when mixed with carbon, with or without the addition of sand, at temperatures as low as 1,300° C. The residue in this case does not fuse to form a slag but remains in a pulverulent condition. Since the temperature at which this reaction occurs is about 300° C. lower than that at which the present types of electrical and fuel-fired furnaces are operated, it seems probable that a considerable reduction

in the cost of phosphoric acid by the volatilization process could be effected by operating at the low temperature.

The chief problem in connection with the low-temperature process was the construction of a furnace capable of handling solid materials in a continuous operation at a temperature of about 1,300° C. and at the same time maintain a reducing atmosphere in contact with the charge. A furnace designed to meet these conditions was constructed; but owing to certain mechanical difficulties it did not experience a successful operation. In order to overcome these difficulties certain necessary changes were made, and the furnace was rebuilt during the past year. The apparatus is now ready for further trial and will be operated within a short time.

In addition to the investigations just described, a study was made of the factors, such as time, temperature, depth of charge, which affect the volatilization of phosphorus from pure tricalcium phosphate when mixed with pure carbon. It was found that the most efficient volatilization was obtained from a thin layer of charge. In connection with this investigation some work was done on the purification of different carbons, involving the removal of volatile matter and ash. The results of this work will be published shortly.

A bibliography of the journal and patent literature pertaining to the volatilization of phosphorus and phosphoric acid was compiled. This includes references to over 100 journal articles, 100 United States patents, and 50 Canadian and other foreign patents. About 20 translations of French and German articles on the subject were made.

A collection of representative samples of materials concerned in the utilization of phosphates for fertilizer purposes, together with a model of an electric furnace for the manufacture of phosphoric acid by the volatilization process, were exhibited at the chemical exposition held in New York City, September 28 to October 3, 1925. The bureau's work on the volatilization process for the manufacture of phosphoric acid was given recognition by representation in a court of chemical achievement held at the exposition. A similar exhibit was prepared and placed on display as a part of the bureau's exhibit at the Philadelphia Sesquicentennial Exposition.

## POTASH INVESTIGATIONS

The investigation of American potash resources during the past year was confined principally to the further elaboration of the potash-recovery process, developed in the Bureau of Soils, in its application to the recovery of potash and by-products from the greensands of New Jersey and other Atlantic States, America's largest known source of potash. This developed process provides for the recovery of potassium sulphate, a most desirable potash salt for fertilizer use; ferric oxide, valued as a pigment; alumina, the essential raw material for the manufacture of metallic aluminum; and glaucosil, a new form of silica, useful in the refining of many commercial products and in various manufacturing operations as an adsorbent of vapors. Since glaucosil gives promise of greater usefulness in certain industries, it seemed essential that the industrial applications of this product be more thoroughly studied. With this in view, further investigations of glaucosil have been conducted particularly to test its efficiency in solvent recovery.

In the study of potash recovery from greensands, a method has been worked out whereby the potash alum obtained as an intermediate product is decomposed by ammonia gas, yielding alumina of ideal characteristics and potassium-ammonium sulphate. This modification in process obviates the thermal decomposition of the alum, a costly and difficult furnace operation heretofore used, thereby greatly simplifying and cheapening the process.

Important industrial groups have under consideration these improved potash-recovery methods with a view to applying them on a large commercial scale, offering prospects of the establishment of a new potash industry based on the utilization of greensand.

The collaboration of this division was solicited to aid in the elaboration of processes for the separation and recovery particularly of the sodium chloride and sodium sulphate from the potash brines of the desert lake region of the Southwest. These products have very low unit value, hence simple and inexpensive methods of separation and recovery are required. To meet this problem of cheap separation, the laboratory of potash investigation developed a process in which advantage is taken of the desert temperature con-



ditions and of the very low humidity of the desert air, in evaporating the appropriate solutions and in crystallizing the salts. In this process the only operating expense is in connection with a moderate amount of pumping of the solution and with the handling of the crystalline products. Temperature-concentration data have been gathered and plotted to aid in the control of this process. The economical separation as merchantable products of the several constituents of these natural potash brines now seems feasible, the proceeds from the sale of by-products greatly enhancing the revenues obtainable and proportionately decreasing the price at which the potash may be sold.

Investigations were made concerning the conversion, by their interaction, of potassium chloride and sulphuric acid, two comparatively cheap materials, into sulphate of potash and hydrochloric acid, two products of greater value. Sulphate of potash is always in special demand in the manufacture of fertilizers, and hydrochloric acid may be used in the manufacture of high-analysis acid phosphate.

In this investigation it has been found that the reaction between potassium chloride and sulphuric acid can be brought to an efficient completion at a much lower temperature than that required in the usual commercial process used in the manufacture of hydrochloric acid, which involves the interaction of sodium chloride and sulphuric acid under conditions of fairly high temperature.

This process investigated, concerning the conversion of potassium chloride into sulphate, will mean, if used in industry, a greater production of hydrochloric acid. A study of the possibilities in the use of this acid, as means for an outlet of this by-product, showed that it may be used in the manufacture of acid phosphate. The use of hydrochloric acid for converting phosphate rock into available phosphates has not been adopted because of the high cost of this acid. Its use in the manufacture of acid phosphate points to the following advantages:

1. It converts the calcium in the raw phosphate rock into calcium chloride, a soluble salt which can be readily removed.

2. The removal of the calcium chloride makes possible the production of a phosphate fertilizer containing about 40 per cent available phosphoric acid ( $P_2O_5$ ).

3. A by-product, calcium chloride, is obtained, for which there is a large demand for use in highway maintenance.

In the manufacture of acid phosphate from raw phosphate rock sulphuric acid is commonly used, this being the cheapest acid available. In this process the calcium in the raw rock is converted into calcium sulphate, an insoluble and unavoidable diluting material. This explains why the ordinary acid phosphate of commerce contains not more than 16 per cent phosphoric acid ( $P_2O_5$ ). The results of these investigations point to greater possibilities in commercial methods of converting chlorides into sulphate.

Exhibits illustrating the bureau's work on potash, showing the various American raw materials and the by-products obtained therefrom, have been prepared and installed at the Sesquicentennial Exposition in Philadelphia. Journal articles have been written presenting the technical details of the potash researches.

#### ORGANIC NITROGEN INVESTIGATIONS

During the year a manuscript for a department bulletin on "Cocoa by-products and their utilization as fertilizer materials" was worked into final form and sent to the printer. This report, to be issued, discusses the utilization for fertilizing purposes of the following by-products: (1) Cocoa press cake; (2) solvent-extracted cocoa, which is the residue left after extracting the cacao butter with benzene from the by-product cake; and (3) cacao shells. The quantities of plant-food elements contained in these by-products are shown in detail, and their importance as possible sources of fertilizer nitrogen is suggested by the fact that the estimated annual production of 25,000 tons of the by-product cake represents close to 1,000 tons of organic nitrogen.

A resumé of present practices in municipal garbage disposal, including disposal by reduction and conversion of the refuse into grease and garbage tankage for fertilizer, was prepared and submitted for publication in an outside newspaper. As a part of this study, first-hand information of a new method of disposal by composting was obtained, and authentic samples of various types of garbage tankage and compost were procured and analyzed.

The composition of representative samples of new or comparatively unknown by-product ammoniates, such as



those prepared from crab and shrimp cannery wastes, were investigated. The results obtained in the laboratory indicate that these by-products should be conserved for use as fertilizer material wherever it is feasible.

Additional experimental work was done on the conversion of the wastes from the small-scale slaughter of animals into fertilizer material. It was found possible to compost the raw offal with certain chemical agents in such a way as to avoid fly breeding and at the same time to conserve much of the fertilizing constituents contained in the original material.

The facilities developed in this work enabled the bureau, in cooperation with the Bureau of Biological Survey, to render quick service to the meat-rabbit industry of the country, by investigating the composition of the wastes resulting from the slaughter of the rabbits, and showing the potential value of these wastes as a source of oil, grease, and fertilizer tankage. In the report of this study, published in

the Western Rabbit Magazine for July, 1926, it is estimated that more than 2 tons of wastes are produced daily in the environs of Los Angeles, Calif.

It is understood that, following publication of the analytical data, a project for reduction of these rabbit wastes for the production of fats and fertilizer tankage has been taken under advisement by officials of the meat-rabbit industry.

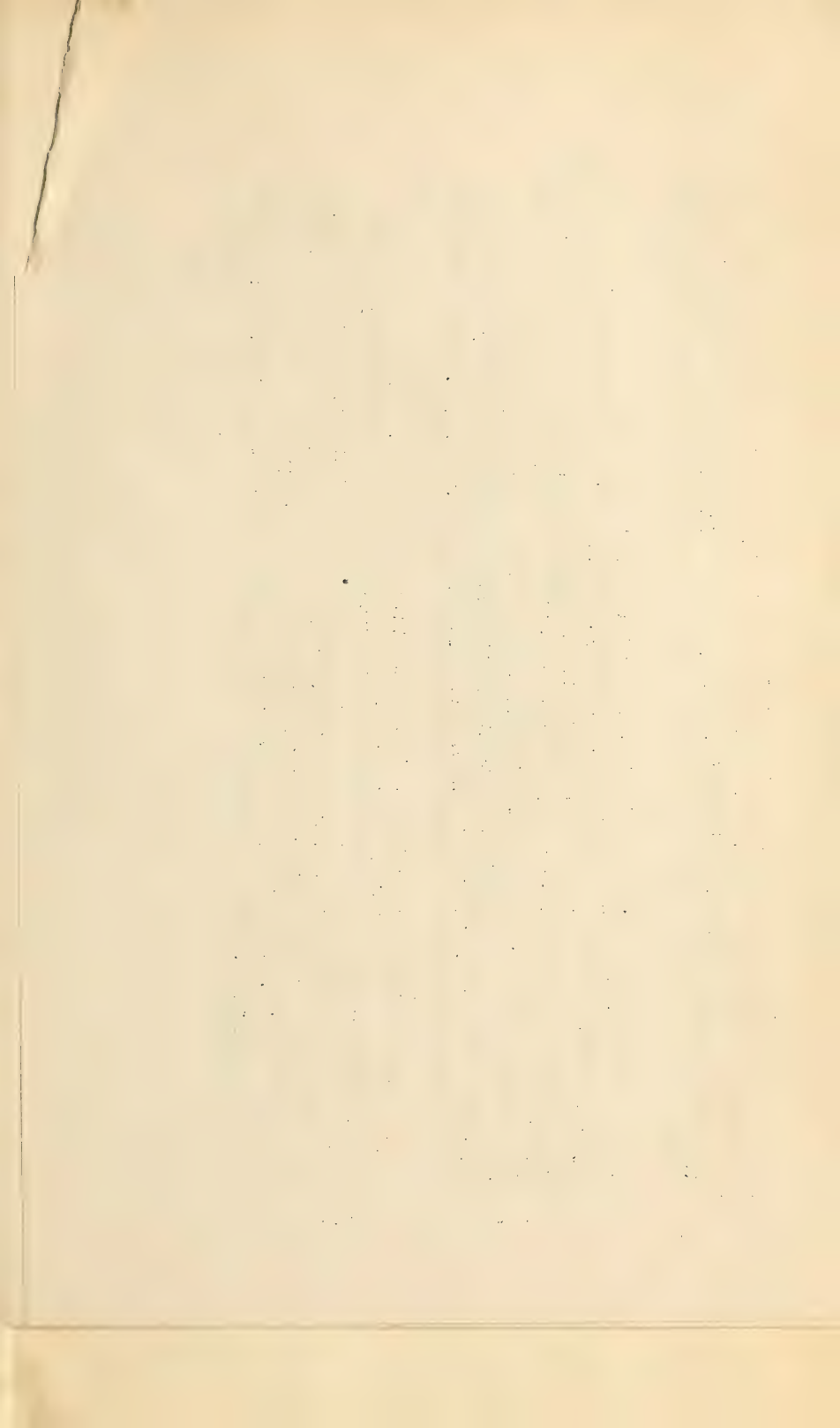
#### MISCELLANEOUS SOIL AMENDMENTS

The work on miscellaneous soil amendments covers projects on the home mixing of fertilizer materials, and on the use of such soil-improvement materials as lime, farm manure, composts, sulphur, and manganese. The work on home mixing was largely confined to experiments with different materials which have been or may be used in the future in home mixing. Work on some of the newer concentrated materials showed that these new materials can be satisfactorily mixed by the farmer.











REPORT OF THE CHIEF OF THE WEATHER BUREAU  
United States Department of Agriculture  
Washington

October 12, 1926.

Document 8 1926

Hon. W. M. Jardine,

Secretary of Agriculture.

Sir:

I have the honor to submit herewith a report of the operations of the Weather Bureau during the fiscal year ended June 30, 1926.

Respectfully,



Chief of Bureau.

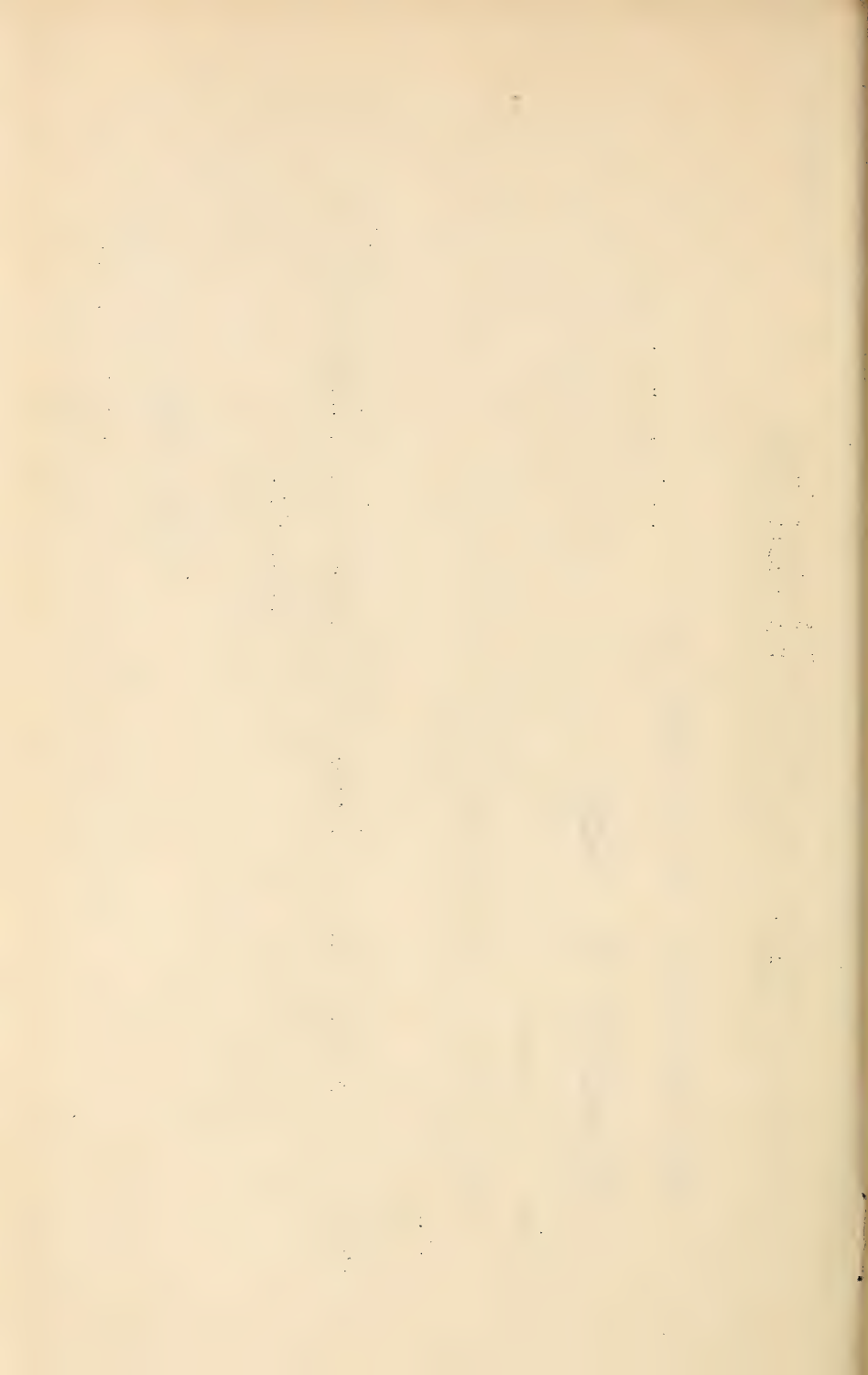
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Conforming to the plan inaugurated a year ago in the interest of economy in printing, the annual report of the Chief of the Weather Bureau for the fiscal year ending June 30, 1926, is submitted in greatly abridged form.

This is the 56th year of the operation of the meteorological service of the United States, and for a score of years or more the field of effort has covered practically every feature of meteorology in a service for the benefit of agriculture, commerce and navigation. The details of these activities have been covered in previous annual reports, and it need be said now only that the work has been maintained at even a higher stage of efficiency and economy, based on experience, than heretofore.

The beneficial effects of the operation of the provisions of re-classification and of retirement of civil employees have expressed themselves in numerous ways, and the personnel of the organization is perhaps in a more satisfied and contented state than at any time since the beginning of the war. Further improvements are gradually being worked out in these respects, and the entire organization of the Weather Bureau is in a good condition.











Legislation in support of air navigation. Many of the public will recall the great agitation that prevailed during a considerable portion of the calendar years 1925 and 1926 in connection with the governmental policy concerning aeronautics. The final outcome of this has been a very satisfactory and definite program of support of both civil and commercial aviation on the part of the Government, in the form of more definite programs for the military branches of the Government, and the enactment of the so-called Air Commerce Act, which had been before Congress in various forms for several years and which charges the Secretary of Commerce with important responsibilities in regard to civil aeronautics. Certain sections of this legislation conclusively define and describe certain duties of the Chief of the Weather Bureau in respect to the conduct of meteorological observations and advices for the benefit of aviation.

During the last days of Congress appropriations were made for carrying into effect the provisions of the Air Commerce Act, and include items for the extension of Weather Bureau work in this field. As these appropriations were not available until the beginning of the new fiscal year, the discussion of work and activities in this field is appropriately deferred until the next annual report.

Fire weather warnings. The enormous economic losses suffered by the public and private forest interests as the result of forest fires have impressed upon the Bureau the importance of furnishing meteorological advices and information to Federal, State, and private forest interests regarding weather conditions adverse to, or favorable for, the inception and spread of fires. The need of funds with which to organize work of this character was stressed in previous years without success until emphatically urged by representatives of the great lumber and forestry interests in the western section of the country. As a result, certain special appropriations were made available to the Weather Bureau for the development and extension of the fire weather warning work which had been inaugurated several years before in a tentative way on a part time basis, with the cooperation of private forestry interests who bore part of the expenses.

As the result of the definite appropriations made for the purpose, a conference was held at Portland, Oregon, in the spring, between representatives of the Weather Bureau, including the Chief of the Bureau, and Federal, State and private agencies of the northwest interested in the forest fire fighting problem. The whole program of meteorological service in aid of forest fire fighting is necessarily a cooperative one, requiring the closest coordination of effort of the forest fire fighting agencies with the forecasters and meteorologists who supply the weather information.

The conference in question is believed to have been productive of a highly satisfactory understanding, and as a result of the conference an outline of the program of work for the fiscal year beginning July 1, 1926, was formulated. It is hoped that the details of this work may be more fully presented and reported upon in the next annual report.

Precipitation and the level of the Great Lakes. It seems appropriate at this point to comment on one of the more notable contributions in the work of the Bureau during the past year, namely, the publication of a carefully









prepared digest of all of the observations available from 1875 to 1924 concerning the precipitation in the drainage area of the Great Lakes, by P. C. Day, in Charge of the Climatological Division. The problem of the decreasing levels of the Great Lakes has become one of critical importance to the States and municipalities adjacent to the Lakes, and especially to the shipping traversing those waters. It is believed that the publication of these very definite facts concerning the water supply to the Great Lakes serves a very definite and valuable purpose in stabilizing thought regarding the causes of changes of lake level.

Those interested in the question must of course consult the original publication, but it seems proper briefly to state that for a score of years or so the records show a general deficiency of precipitation as compared to averages of annual precipitation prevailing over an equal period of years preceding the opening of the twentieth century. The Weather Bureau is disposed to believe such differences in precipitation represent changes over relatively short intervals of time, and that recurrences of wet periods, so called, may reasonably be expected, in which case it is the Bureau's opinion that there will be a corresponding increase in the lake levels, with the accompanying benefits to shipping and other interests.







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